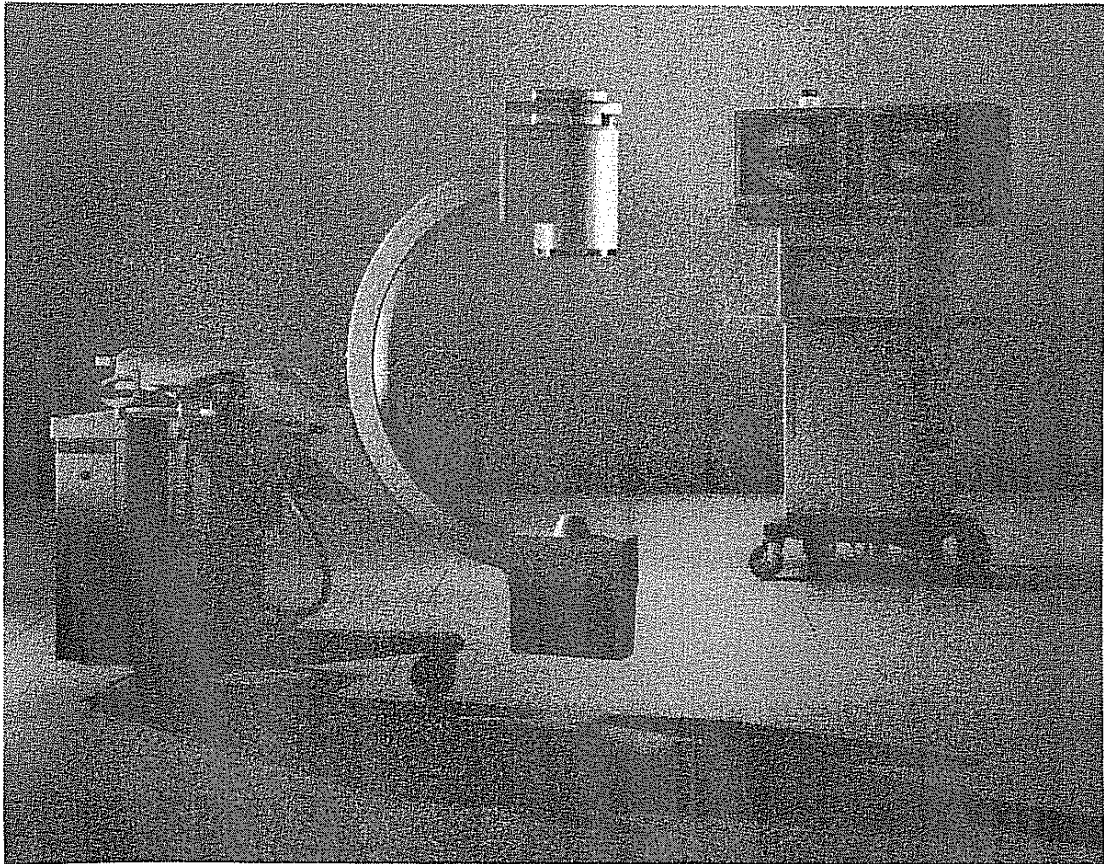


SERVICE MANUAL-SYSTEM

Mobile Surgical X-ray System

BV25-S

9896 000 06451



This manual contains information on the Mobile Surgical X-ray System BV25-S.
It is used for TV fluoroscopy with image intensifier and for radiography
in operating and emergency rooms.

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SERVICE MANUAL-SYSTEM
MOBILE SURGICAL X-RAY SYSTEM BV25-S

9896 000 06451

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* PRINTING INSTRUCTIONS: 4522 983 50742 *

BV25

(a/93.0)

2.3

Section A: Introduction and technical data

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1. PURPOSE

The BV25-S system is a Mobile X-ray system for surgical applications. It is used in operating and emergency rooms for fluoroscopy with television and image intensifier, and for radiography.

2. VERSIONS

The BV25-S is factory-adjusted, dedicated 50 Hz or 60 Hz system.
BV25-S is equipped with one or two 43 cm TV monitors.
The typenumbers for the BV25 can be found in the commercial catalogue.

3. ITEMS SUPPLIED

3.1. ITEMS DELIVERED IN CASE

1. Mobile stand with C-arm + one or two monitor(s).
2. Mobile trolley with stand-trolley connection cable and mains cable.
3. Image video memory.
4. Carton box with documentation and accessories in storage compartment from mobile trolley, see items numbered below.
5. Two small boxes with:
 - o spare fuses 30A (120 V), 15 A (220 V), 10 A
 - o tube P4 silicone grease
 - o lens paper
 - o equipotential conductor + 3 pins + 9 washers/nuts
 - o paint set (with brush) mushroom - brown
 - o plastic bags with installation materials

6. Set of 5 sterilizable covers for C-arm, Practix-C tank, and shield I.I. (option)
7. Footswitch
8. Cassette holder IEC (Option)
9. Cassette holder + 2 guide strips for grid, when ordered.
10. Set of service documentation (2 volumes)
11. Operator's manual BV25
12. Manufacturing documents:
 - o Status Report Fluoroscopy BV25
 - o Configuration list BV25
 - o Licence HH 41/82 Rø for Practix C tank ("Zulassungsschein").
 - o A.P. certificate (IEC)
 - o List of service manuals

3.2. CABLES

The system cabling diagram is shown in drawing Z2-2.

For the stand and memory box the interface cables are described in drawings Z2-3 to Z2-6.

4. EQUIPMENT IDENTIFICATION

The location of PEI number plates and labels is given in the appropriate PEI documentation. A central information place, marked "I", for labels is on the Mobile Stand, see AZ-2.

BV25 systems are identified with a unique serial number CExxxx. The serial number can be found in the central information place, and on the status report fluoroscopy.

5. TECHNICAL DATA

5.1. PERFORMANCE DATA

5.1.1. X-ray source

X-ray generator : High Voltage DC Converter.

X-ray tube F014 : Dual-focus stationary anode,
focal spots 0.6 mm and 1.5 mm.

5.1.2. Fluoroscopy

Image intensifier : 15 cm high quantum absorption type with fibre output.

Optical coupling
I.I. tube-
T.V. camera : Lens optics.

Source-to-image
distance : SID 90 cm.

Dose rate control : Automatic with simultaneous kV/mA control, and manual.

kV/mA range : 40 kV/0.1 mA
50 kV/0.4 mA
70 kV/2.6 mA
105 kV/3.1 mA

Focal spot : 0.6 mm.

Maximum load X-ray
tube : 30 sec. on - 120 sec. off during 90 minutes fluoroscopy at max. 100 kV - 3 mA.
Average continuous load: 60 Watt.

Grid : Fixed circular grid, 44 lines/cm -
ratio 8 - SID = 90 cm.

Collimator : Electronically controlled iris diaphragm with field sizes stepless adjustable between
Ø 5 cm and Ø 15 cm, measured at entrance plane of image intensifier.

Two semitransparent shutters of 0.5 mm Cu, stepless adjustable for a slit aperture
of 1 to 16 cm measured at entrance plane of image intensifier. The shutters can
be rotated $\pm 90^\circ$; in mid position, the slit aperture is perpendicular to length of tank-
housing.

Fluoroscopy modes.

Continuous fluoroscopy	: With automatic dose rate control and automatic video gain control of T.V. system; kV and mA values coupled. With manual dose rate control and automatic or fixed video gain control of T.V. system; kV- and mA-values coupled. Adjustment by button: 1 kV/step.
Pulsed fluoroscopy	: Intermittent X-ray radiation for reduced dose with automatic or manual dose rate control, and image storage and display by Scopofix. X-ray pulses of about 550 msec. produced each 2-7 seconds.
Single-shot fluoroscopy	: One single exposure made for each activation of snapshot footswitch, with image storage and display by Scopofix. During snapshot, the tube current is 2.4 times higher than in normal fluoroscopy.
TV system	: XTV8S with standard line rate: 50 Hz version, CCIR composite video (625 lines) 60 Hz version, EIA composite video (525 lines)
Bandwidth	: > 9 MHz for XTV8S
Control	: Automatic Video Gain Control (AGC) for maintaining constant average image brightness with feedback to ADC. AGC operates in top mode with threshold of 400 mV. Automatic Dose rate Control (ADC) for obtaining constant average dose at image intensifier input screen. ADC for kV control operates in top mode.
Video monitor	: Single monitor with 43 cm screen and remote control of horizontal image reversal.
Output signal	: 1 Vpp composite across 75 Ohms.
TV monitor circle	: About 25 cm.
Compatible equipment	: Multi image camera. Multi image camera can be used to provide hard copies without endangering sterility. Patient I.D. writer

5.1.3. Radiography

X-ray tube voltage
and current : 40 kV - 20 mA up to 105 kV - 20 mA
(French homologation) : 101 kV - 30 mA up to 105 kV - 30 mA

Voltage adjustment
by button : 1 kV/step
Exposure time adjustment
by button : 0.01-4.0 sec. at 20 mA
(French homologation) : 0.01-0.32sec.
Preparation time : 0.8 sec.

Focal spot : 1.5 mm

Maximum load of X-ray tube at
100 kV (20 mA) : 4 sec. on, 120 sec. off
(ca. 30 exp./hour)

Cassette holder : Suitable for cassette
and grid cassettes:
IEC, 24 x 30 cm
20 x 40 cm

5.1.4. Filtering

Total inherent filtration of 4 mm Al equivalent.

5.1.5. Manoeuvrability

Vertical movement of C-arm (motorized)	: 50 cm
Longitudinal movement of C-arm	: 20 cm
Pivoting movement of C-arm on vertical axis	: -12.5° to +12.5°
Rotating movement of C-arm on horizontal axis	: -155° to +155°
Orbital movement of C-arm in guide way	: -25° to +90°
Force to operate longitudinal movement of C-arm	: <40 N
Moment to operate pivoting movement of C-arm	: <10 Nm
Force to operate rotating movement of C-arm	: 20 Nm
Moment to operate orbital movement with C-arm vertical	: <20 Nm
Moment to operate orbital movement with C-arm horizontal	: <50 Nm
Brake handle orbital movement of C-arm	: <75 N
Brake handle rotating movement of C-arm	: <75 N
Brake handle longitudinal movement of C-arm	: <100 N
Brake handle pivoting movement of C-arm	: <100 N
Force to move stand/to keep it moving	: <50 N/<30 N
Force to move trolley/to keep it moving (without Scopofix)	: <50 N/<30 N
Force to move trolley/to keep it moving (with Scopofix)	: <80 N/<50 N

5.2. MECHANICAL ADAPTATION DATA

The Mobile stand houses the following units/PEI's:

- X-ray control unit
- Vertical movement control unit
- System control panel
- 15 cm I.I. tube
- HT cascade generator for 15 cm I.I. tube
- Container for 15 cm I.I. tube and TV camera
- Practix-C tank with double focus X-ray tube
- Diaphragm
- System power supply

The cassette holder is attached to the container of the I.I. tube.

The sterilizable covers are attached to the container of the I.I. tube, the C-arm and the Practix-C tank (AZ-2).

The Mobile trolley houses the following units/PEI's:

- Mains control unit
- 43 cm TV monitor(s)
- Scopofix control unit
- Image video memory.
- Patient data unit, (option)
- Video hard copy unit, (option)

5.3. SUPPLY REQUIREMENTS

5.3.1. Mains supply

Connection	: 7 m mains cable with plug for wall socket.
Voltage	: 100, 110, 120, 130, 200, 210, 220, 230, 240 V AC \pm 10%, single phase.
Resistance	: 0.1, 0.1, 0.12, 0.15, 0.5, 0.55, 0.6, 0.65 resp 0.75 Ohms.
Frequency	: 50/60 Hz \pm 1%
Leakage current	: <100 μ A

5.3.2. Maximum current (at switch-on)

35 A at 100-130 V AC. Fuse with 35 A slow.

20 A at 200-240 V AC. Fuse with 16 A slow.

NOTE

We recommend a slow type of fuses, because the fast responding electromagnetic overload releases, when used in a hospital, may cause problems.

5.3.3. Power consumption

Standby : 1100 W - 6.5 A r.m.s. at 220 V
Fluoroscopy : 1550 W - 10.5 A r.m.s. at 220 V
Radiography : 4700 W - 26.5 A r.m.s. at 220 V

5.3.4. DC power supply

+24 V \pm 1.5% - I_{max} = 6 A
+15 V \pm 1.5% - I_{max} = 6 A
+10 V - I_{max} = 60 mA
+ 6.4 V \pm 1.5% - I_{max} = 3 A
+ 5 V \pm 1.5% - I_{max} = 6 A
-15 V \pm 1.5% - I_{max} = 6 A

5.3.5. D.C. power supply for Stand Alone Operation

- 18V D.C. for Scopofix 25 when the trolley is used
in Stand Alone Operation.

5.4. ENVIRONMENTAL DATA

The mobile surgical system BV25 complies with the MSD classification C1, M2, S2.

C1: indoor use, under conditions normally found in theatre and emergency rooms.

M2: mobile conditions, repetitive transport and stationary conditions during operation.

S2: mains supply conditions.

Operating ambient

temperature : +10°C to +40°C

Operating relative

humidity : 20% to 90%, no condensation

Air pressure : 500 - 1060 mbar

Emission of transients : according to VDE 0875,
degree N

Magnetic interference : according to IEC 62A, par. 16

Acoustical noise : <45 dB at 1 meter from system
in frequency range of 300 Hz -16 kHz.

5.5. TRANSPORT AND HANDLING

5.5.1. Size and Weights

Size of stand and trolley : See Z9-1, Z9-2

Size of packing : 245 x 115 x 147 cm (l x w x h)

Total weight including packing: 620 kg

Weight of mobile stand : 250 kg

Weight of mobile trolley : 219 kg (2 TV monitors + Scopofix MDPM)

5.5.2. Environmental

storage ambient temperature	: -25°C to +70°C
storage relative humidity	: 10% to 95%
vibration test, transport	: 10-150 hz, 0.35 mm amplitude, 5g acceleration
operation	: 10-150 hz, 0.15 mm amplitude, 2g acceleration
shock test, transport	: 6000 bumps, 25 g acceleration, 6 msec pulse duration
operation	: 25 g acceleration, 6 msec pulse duration

5.5.3. Cleanability

Resistant against water drip, soap, hot water, disinfectants.

5.6. IEC CLASSIFICATION

- Class I
- Type B
- Anaesthetic proof (AP) according to IEC-601.1

5.7. APPLICABLE STANDARDS

- IEC publication 601-1, 1977
- IEC 62A/55, 1981
- IEC 62B/65
- IEC publication 406-407
- DIN 6811, 1972
- VDE 0871/6.78, class B, 0875/7.71 class N
- Röntgen Verordnung
- CISPR publication II and IIA, 1975.

6. CERTIFIABLE ITEMS

The BV25 system consists of the following certifiable components:

COMPONENT TYPE
Tube Housing Assembly
Beam limiting Device
Image Intensifier
X-Ray Control (XTV)
X-Ray Control (STAND)

Optional:

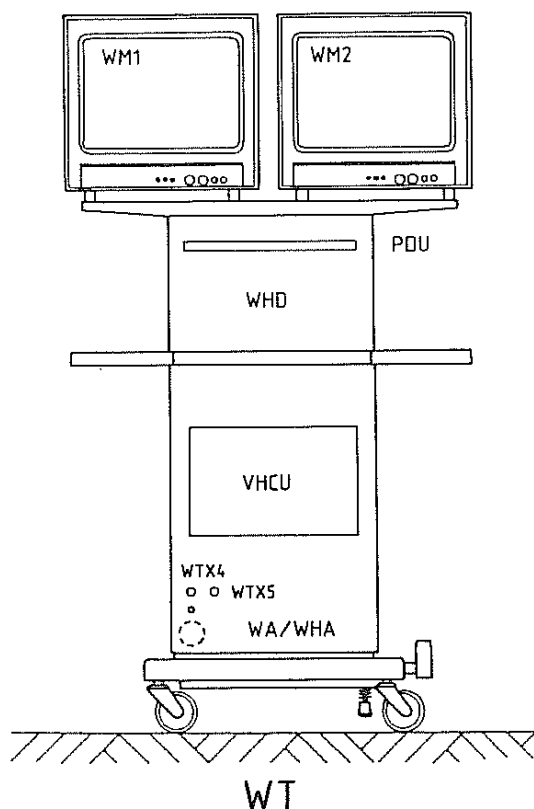
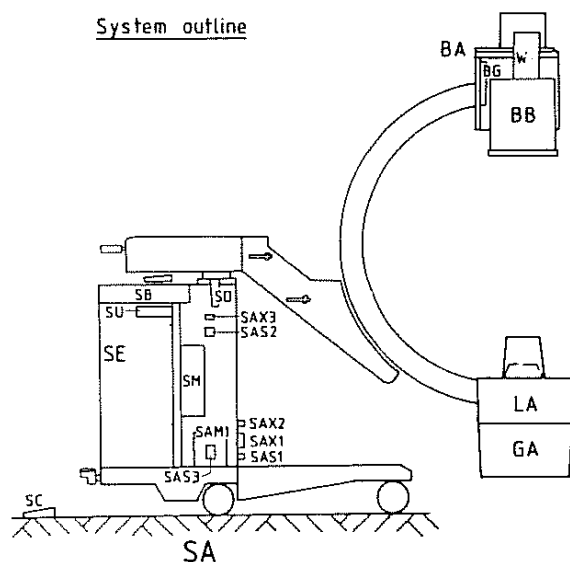
Spotfilm device (labels only on spotfilm device).

Television Receiver (labels only on television receiver device).

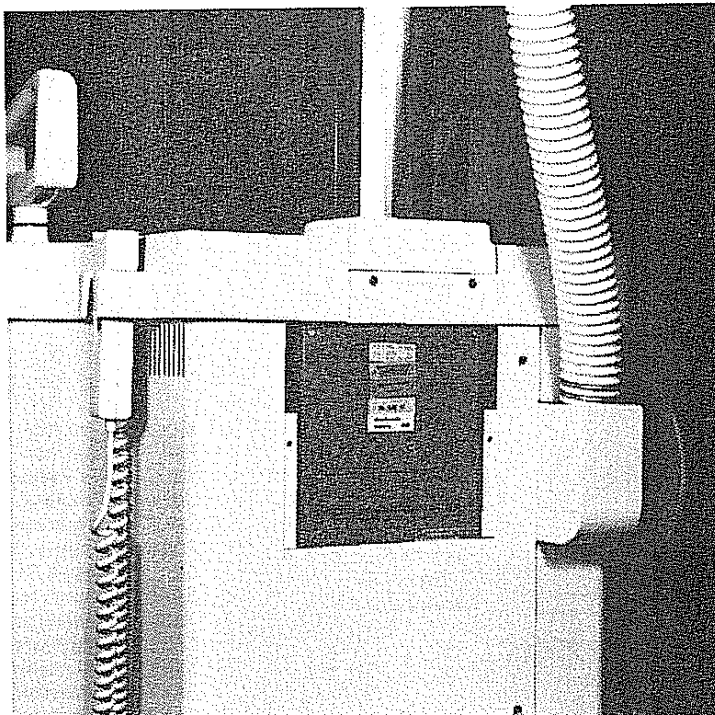
WARNING

IN CASE OF REPLACEMENT OF CERTIFIABLE ITEMS ALWAYS REPLACE DUPLICATE LABEL ON
CENTRAL LABELING STATION.

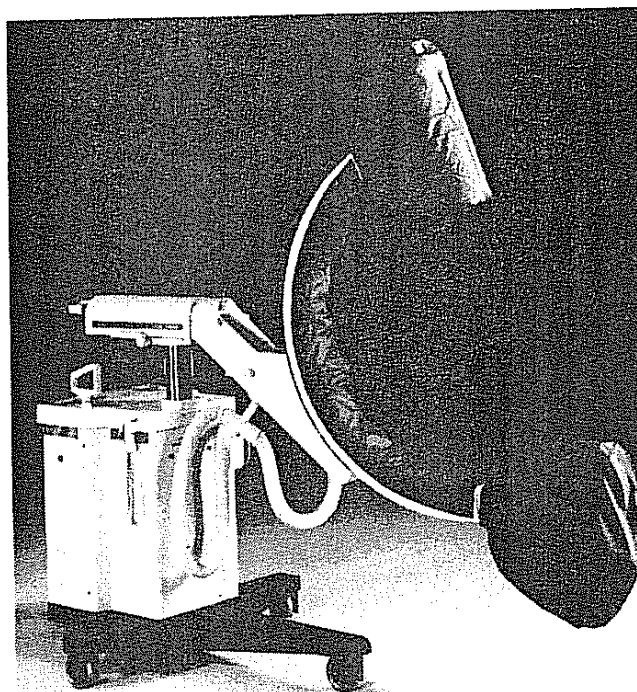
6. ILLUSTRATIONS



BA	Mounting plate for II-shield
BB	15cm (6") I.I.-tube
BG	HT cascade generator for I.I.-tube
GA	Practix-C tank with X-ray tube
LA	Diaphragm
PDU	Patient Data Unit
SA	Mobile Stand
SAM1	Motor for vertical C-arm movement
SAS1	Switch as sensor for SAX1 connector
SAS2	End switch C-arm up
SAS3	End switch C-arm down
SAX1	Connector for stand-trolley cable
SAX2	Connector for footswitch cable
SAX3	Connector for handswitch cable
SB	System control panel
SC	Footswitch
SD	Handswitch
SE	X-ray control
SM	Vertical movement control
SU	System power supply
VHCU	Video Hard Copy Unit
WA	Mains control unit
WHA	Scopifix control
WHD	Digital Scopifix
WHS1	Noise integration on/off switch
WK	TV camera
WM1	TV monitor-L
WM2	TV monitor-R
WT	Mobile trolley
WTX3	Connector for stand alone operation
WTX4	Video out connector from monitor-R
WTX5	Video out connector from monitor-L



Behind lid the type numbers and labels are attached.
At replacement of type numbers, the type numbers and labels must be updated.



Set sterilizable covers for I.I., tank and C-arm

Section B:
Installation

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1. INTRODUCTION

This section contains instructions for unpacking, installing and programming the mobile surgical system BV25.

2. TOOLS

A standard toolset is required to unpack and to install the BV25.

3. UNPACKING INSTRUCTIONS

The BV25 system is packed in 1 case: (245 x 115 x 146 cm).
The unpacking instructions are delivered with the shipping packaging.

4. INSTALLATION INSTRUCTIONS

4.1. INSTALLATION OF TV-MONITOR(S) ON MOBILE TROLLEY

The Mobile trolley of the BV25 can be equipped with one or two top mounted 43 cm TV monitors. Installation of two TV monitors requires a mounting set for two TV monitors. The code number for this set can be found in the commercial catalogue.

4.1.1. Installation of one TV-monitor

To install a single TV monitor on the Mobile trolley, proceed as follows:

- (1) Unpack TV monitor.
- (2) Loosen side covers (above grip) a bit and pull off covers at the front and at the rear of Mobile trolley.
- (3) Fit TV-monitor at the top of Mobile trolley.
- (4) Mount TV-monitor with 4x screw M5x25 and spring washers M5.
- (5) Remove cover at the rear of TV monitor.
- (6) Attach mains cable plug, remote control plug and video coax plug to the appropriate sockets (X1, X4, X3). Check switch for 75 Ohms termination.(see BZ-1)
- (7) Replace covers at the front and at the rear of Mobile trolley and tighten side covers.
Guide monitor cables through cut-out in cover at the rear.
- (8) Replace cover at the rear of TV monitor.

4.1.2. Installation of two TV-monitors

To install two TV monitors on the Mobile trolley a mounting set for two TV monitors is required.

Proceed as follows:

- (1) Unpack TV monitors and materials of mounting set.
- (2) Loosen side covers (above grips) and pull off covers at the front and at the rear of Mobile trolley.
- (3) Mount carrier plate with 4x screws M6 (from inside) in holes (at corner) at top of Mobile trolley. Use 4x spring washer M6 and 4x earth washer.
- (4) Fit TV monitors in holes in carrier plate.
- (5) Mount TV monitors with 8x screw M5x25, washers and spring washers to carrier.
- (6) Remove covers at the rear of TV monitor.
- (7) Attach mains cable plug, remote control plug and video coax plug to the appropriate sockets (X1, X4, X3) of TV monitor WM1 (at the left seen from the front).
- (8) Loosen side covers (below grip) and pull off covers at the front and the rear of Mobile trolley.
- (9) Guide mains cable and video coax cable for second monitor along the existing cables and attach mains cable to connector WAX1 of mains control unit and video coax cable to BNC connector WHA1:X7 (Monitor-R on board WHA1).
- (10) Attach mains cable plug and video coax plug to the appropriate sockets (X1, X3) of TV monitor WM2 (at the right).
- (11) Check both TV monitors for 75 Ohms termination.
- (12) Replace covers at the side, at the front and at the rear of Mobile trolley and tighten side covers. Guide monitor cable through cut-out in cover at the rear.
- (13) Before replacing covers of TV monitor, adjust centre of 2nd monitor circle: see F4.3.4.
- (14) Remove small grips at each side of Mobile trolley and attach large grips.

5. INSTALLATION OF IMAGE VIDEO MEMORY

To install the video memory, in mobile trolley, proceed as follows:

- (1) Unpack video memory. It is packed in a separate carton to prevent damage during transportation. Save carton for return shipment.
- (2) Loosen side covers (above and below grips) and pull off covers at the front and at the rear of mobile trolley.
Remove left cover too.
- (3) Remove base plate in top position from support brackets inside mobile trolley. (2x screws M4 at the front).
- (4) Mount memory to baseplate with mounting material supplied with BV25, in plastic box.
- (5) Slide video memory with base plate attached on support brackets in Mobile Trolley and lock base plate on support brackets with 2x M4 screws.
- (6) Attach mains plug to mains socket at the rear, and check voltage select switch for 220V a.c. position (interval a.c. supply voltage in BV25 is 220V).
- (7) Attach video-in and video-out plugs and remote/interface plugs to appropriate sockets at the rear of video memory as follows:

BV25 SCOPOFIX	MDP, MDPM
Video-in WHD IN	VIDEO IN
Video out WHD OUT 1	VIDEO OUT 1
Video out WHD OUT 2	VIDEO OUT 2
WHD X10	Not connected
WHD X11	Not connected
WHD X12	Not connected
WHD X2	50-p remote

Do not cut off unused cable plugs. Insulate plugs and tie them up to cable.

- (8) Adapt memory to the mains frequency as follows:

MAINS FREQUENCY	Jumper WHD25:W1 in MDP(M)
50 Hz	50 Hz
60 Hz	60 Hz

- (9) Detach blank socket at WAX1 at the rear of mains control unit (see BZ-1) and fit bush-ended wires of mains cable in socket positions 4-5: 220 V a.c. and socket position 6: ground (green/yellow).
- (10) Replace covers at the side rear and lower front. Mount top front-cover supplied with BV25 system, except for Digital Scopofix MDPM.
For MDPM memory remove blank plate from top cover, and replace MDPM front in top cover (4x screw).
Unlock disk protection screws via lefthand side panel of trolley.
Connect flat cable to socket WHDX40:X1 at front panel. Tighten side covers.

6. INSTALLATION OF BV25 CABLES

- (1) Connect the Burndy plug of the stand-trolley connection cable to socket SAX1 at the mobile stand.(see BZ-1)
- (2) Connect the Burndy plug of the dual footswitch cable to socket SAX2 at the mobile stand.
- (3) If required, connect also the yellow/green equipotential conductor from the grounding pin at the mobile stand to the operating table.
- (4) Before connecting the mains voltage plug to the mains supply wall socket, set the mains input voltage in the BV25 in accordance with paragraph 6.1

6.1. ADAPTATION MAINS VOLTAGE AND FUSES

At delivery the 50 Hz BV25-IEC systems have been set up to operate on a mains input voltage of 220 V a.c. with 15 amps fuses F1 and F2, and the 60 HZ BV25-IEC systems on a mains input voltage of 120 volts a.c. with 30 amps fuses F1 and F2.(see BZ-2)

NOTE

*BV25 system can be powered from standard mains outlets in hospital.
However because of maximum current it is recommended to connect a BV25 system to a separate phase group, when more equipment uses the same group.*

To adapt the mains input voltage in the mobile trolley, proceed as follows:

- (1) Loosen side covers (below grips) and pull off cover at the rear.
- (2) Program mains input voltage at terminal block WA100.(see BZ-2)

The BV25 can be set-up to operate on 100, 110, 120, 130, 200, 210, 220, 230 and 240 V A.C. by setting wires 1, 2, 3, 4, 5, 6 at the terminal block WA100 in the mobile trolley as follows:

MAINS VOLTAGE	FUSES F1,F2	LEAD CONNECTED TO:					
		1	2	3	4	5	6
100 V	30 A	104	107	110	109	122	125
110 V	30 A	104	107	108	105	122	125
120 V	30 A	104	107	108	109	122	125
130 V	30 A	104	107	108	110	122	125
200 V	15 A	105	106	110	108	123	124
220 V	15 A	105	106	108	107	123	124
240 V	15 A	105	106	108	110	123	124

At all mains input voltages listed, the internal a.c. supply voltage in the BV25 is 220 v, except the mains voltage to the h.V. Converter input, being 594 V a.c.[†]

7. PROGRAMMING FACILITIES

7.1. PROGRAMMING INSTRUCTIONS

For the programming instructions of

- TV monitor
- XTV8S
- Digital Scopofix MDP(M)
- Patient Data Unit
- Video Hard Copy Unit.

see the appropriate service manuals.

7.1.1. Mobile Stand - XRC Unit

PC board	Jumper	Position	Remark
SE11	W1	1-2	Copy on (MDPM memory)
		1-3	Copy off (MDP memory)
	W2	1-2	Sub on
		1-3	Sub off
	W3	1-2	Fix on
		1-3	Fix off
	W4	1-2	ADD for MDP(M)
		1-3	SUB for HR DP(M)
SE13	W1	1-2	Auto AGC in manual fluoroscopy.
	W2	1-3	Manual AGC in manual fluoroscopy.
		1-2	Measuring field depends on kV value.
		1-3	Always small measuring field.
SE17	W1	1-2 1-3	Adjust for normal dose Adjust for high dose
SE19	W1	FLUO	Measuring 0.1-3.0 mA during fluoroscopy.
	W2	RAD	Measuring 20 mA at radiography.
		STD	40-100 kV radiography.
		FRN	40-100 kV/20 mA and 101-105 kV/30 mA radiography.
	W3	CONTR	kV-mA coupled via curve.
		SERV	mA manual control.
	SE21	W1	4-5
W2		1-2	40cm iris size IEC
		4-5	15cm iris size HHS
W3		1-2	30cm iris size HHS
		NORMAL	5-15 cm iris size
W4		ADJ.IR	Iris size adjustment
		NORMAL	Small focus at fluoroscopy
		FLUO-LF	Large focus at fluoroscopy
SE33	W1	50 Hz 60 Hz	System dependent System dependent
SE37	W1	Inst'd Rem'd	Enable inverter alarm Disable inverter alarm

7.1.2. Scopifix Control

PC board	Jumper	Position	Remark
WHA1	W1 W2 A,B	BLANK FREE NORMAL HLR	Single memory Double memory 625/525 TV lines 1249/1049 TV lines
WHA2	W1	1-2 2-3	2 TV monitors 1 TV monitor
WHA3 for MSP, MDP(M)	W1 W2 W3 W4 W5 W7	1-2 1-3 1-2 1-3 A1-B1 A2-B2 A3-B3 A1-B1 A2-B2 A3-B3 A1-B1 A2-B2 A3-B3 1-2 1-3	Gamma VHCU off Gamma VHCU on Gamma monitor off Gamma monitor on k=1/2 live fluoro mode k=1/4 live fluoro mode k=1/4 --> 1/2 live fluoro mode k=1/2 pulsed/snapshot fluoro mode k=1/4 pulsed/snapshot fluoro mode k=1/4 --> 1/2 pulsed/snapshot fluoro mode First frame snapshot without integration First frame <i>snapshot/pulsed fluoro without integration</i> First frame with integration 50 Hz BV25 system 60 Hz BV25 system
Switch WT:S1 (rear of trolley)		ON OFF	Integration high Integration low

7.2. PROGRAMMING AS DELIVERED

7.2.1. Mobile Stand - XRC Unit

PC board	Jumper	Position	Remark
SE11	W1	1-2	Copy on (MDPM memory)
		1-3	Copy off (MDP memory)
	W2	1-2	Sub on
	W3	1-2	Fix on
	W4	1-2	ADD for MDP(M)
SE13	W1	1-3	Manual AGC in manual fluoroscopy.
	W2	1-2	Measuring field depends on kV value.
SE17	W1	1-2	Adjust for normal dose
SE19	W1	FLUO	Measuring 0.1-3.0 mA during fluoroscopy.
	W2	STD	40-100 kV radiography.
	W3	CONTR	kV-mA coupled via curve.
SE21	W1	4-5	24cm iris size (HHS versions)
		1-2	40cm iris size (IEC versions)
	W2	4-5	15cm iris size (HHS versions)
		1-2	30cm iris size (IEC versions)
	W3	NORMAL	5-15 cm iris size
	W4	NORMAL	Small focus at fluoroscopy
SE33	W1	50 Hz	50 Hz BV25 system
		60 Hz	60 Hz BV25 system
SE37	W1	Inst'd	Enable inverter alarm

7.2.2. Scopofix Control

PC board	Jumper	Position	Remark
WHA1	W1 W2	FREE NORMAL	Double memory 625/525 TV lines
WHA2	W1	1-2	Single memory and 1 TV monitor
WHA3 for MSP, MDP(M)	W1 W2 W3 W4 W5 W7	1-2 1-2 A3-B3 A1-B1 A1-B1 1-2 1-3	Gamma VHCU off Gamma monitor off k=1/4 --> 1/2 live fluoro mode k=1/2 pulsed/snapshot fluoro mode First frame snapshot without integration 50 Hz BV25 system 60 Hz BV25 system
Switch WT:S1 (rear of trolley)		ON	Integration high

7.2.3. Mains Control Unit

PCB	JUMPER	POSITION	REMARKS
WA1	W1	1-2	Enable keying

Wire	Connected to	Remark
1	WA105	BV25 IEC 220 V, 50 Hz Fuses WA:F1, F2 15 A.
2	WA106	
3	WA108	
4	WA107	
5	WA123	
6	WA124	

Wire	Connected to	Remark
1	WA104	BV25 HHS 120 V, 60 Hz Fuses WA:F1, F2 30 A.
2	WA107	
3	WA108	
4	WA109	
5	WA122	
6	WA125	

7.2.4. XTV8S TV chain

PCB	JUMPER/ SWITCH	POSITION	REMARK
WK3 AGC/ADC1	W1 W2 W3	2 - 3 2 - 3 2 - 3	Block generator off Rampgenerator off Videoproc. normal use
	X19	A2 - 3 or A1 - 2	Cable compensation (not used)
WK4 AGC/ADC2	W1	1 - 2	Clean circle on
	S1 - 1	on	Surgery
	S2 - 1 S2 - 2 S2 - 3 S2 - 4 S2 - 5 S2 - 6	on on on on off on	X-tal lock Contour correction Frame accumulation White compression curve 1 Normal use Max. VIBS level 1100 mV
	S3 - 1 S3 - 2 S3 - 3 S3 - 4 S3 - 5 S3 - 6 S3 - 7 S3 - 8	on on on on on on on off	Horizontal image normal Not used MF relative value MF remote selectable Not used Soft-rise off
WK5 Videoproc.	S1 S2	7 Left	Largest circle blanking Normal use

7.2.5. TV monitor 43 cm.

PCB	JUMPER	POSITION	REMARKS
WM10	W1 W2 W3 W4 W5 W6 W7 W8	A A A 1-2 1-2 1-3 1-2 1-2	Double frame frequency Double frame frequency 3:4 scan ratio sync. internal LDR switched off 3:4 scan ratio normal line rate Brightness correction standard Contrast correction standard
	S1	1-2	75 Ohm termination of WM10X1

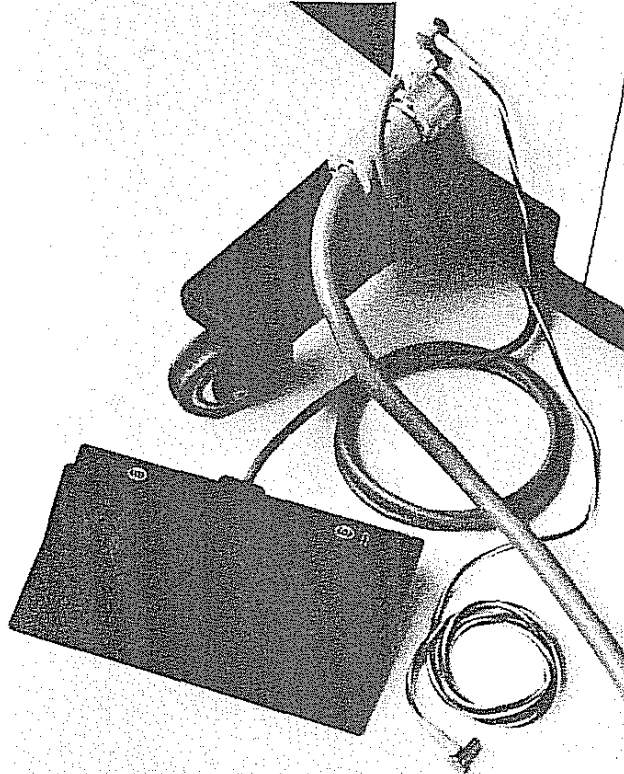
7.2.6. Digital Scopofix MDP(M)

PCB	JUMPER	POSITION	REMARKS
WHD11	S1	OFF	No test pattern
WHD19	S1 S2 S3 S4.1 S4.2	2 1 3 CLOSED CLOSED	Multiplication fact. 2 for SUB1 Multiplication fact. 2 for SUB1 Grey level added as background Grey level added as background Grey level added as background
WHD23 (MDPM)	W1-W8 W10 W9 W11 W14 W12 W13	1-2 1-2 5-6 3-4 3-4 5-6 9-10 13-14 1-2 7-8 REMOVED 1-2	Buffer memory 16k Buffer memory 16k Buffer memory 16k Harddisk installed Harddisk installed Harddisk installed Harddisk installed Harddisk installed Harddisk installed No PLL delay High density
WHD25	W1	1-2 1-3	50 Hz BV25 system 60 Hz BV25 system

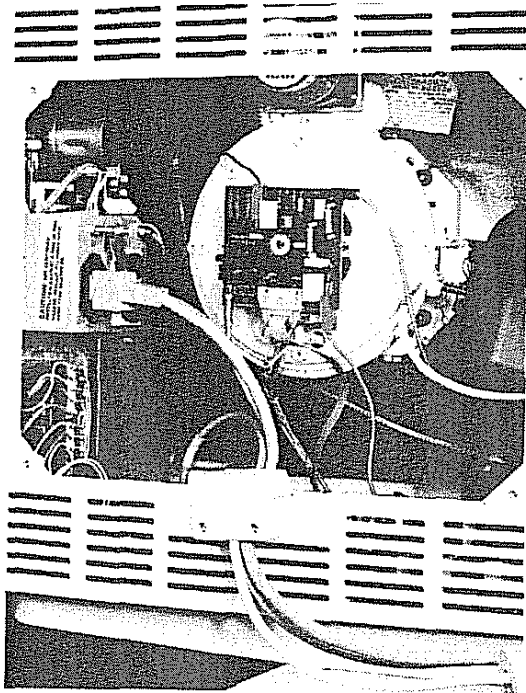
7.2.7. Patient data unit

PCB	DIPSWITCH	POSITION	REMARKS
CPU	S2.3 S2.3	OFF ON	50 Hz BV25 system 60 Hz BV25 system
CRT1	W1 S2	INSTALLED INSTALLED	50 Hz BV25 system 60 Hz BV25 system

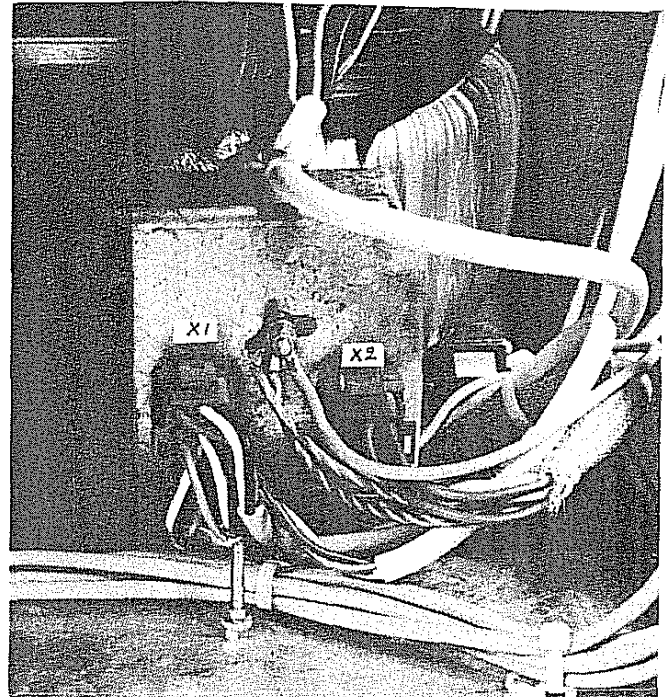
8. ILLUSTRATIONS



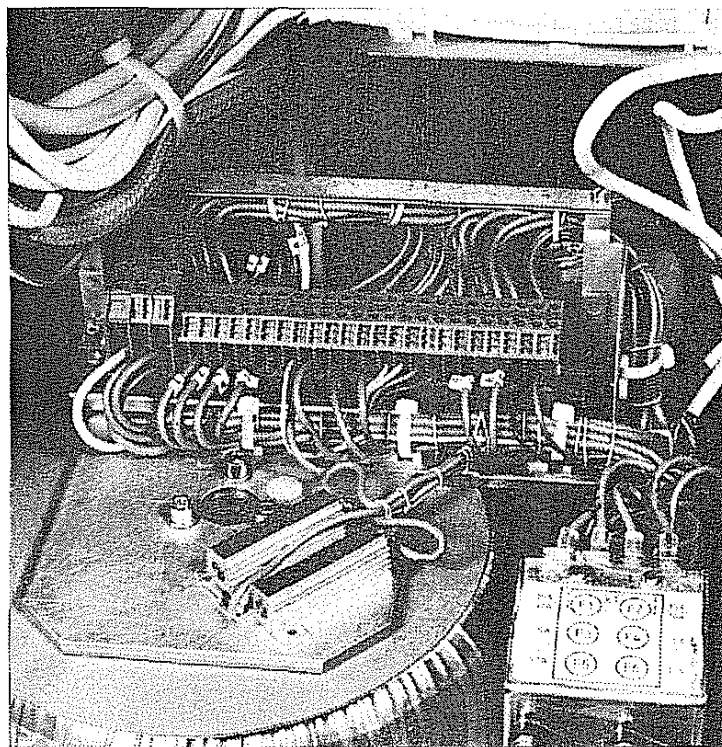
1) Connection of Stand-trolley cable, footswitch cable and equipotential conductor to Mobile stand.



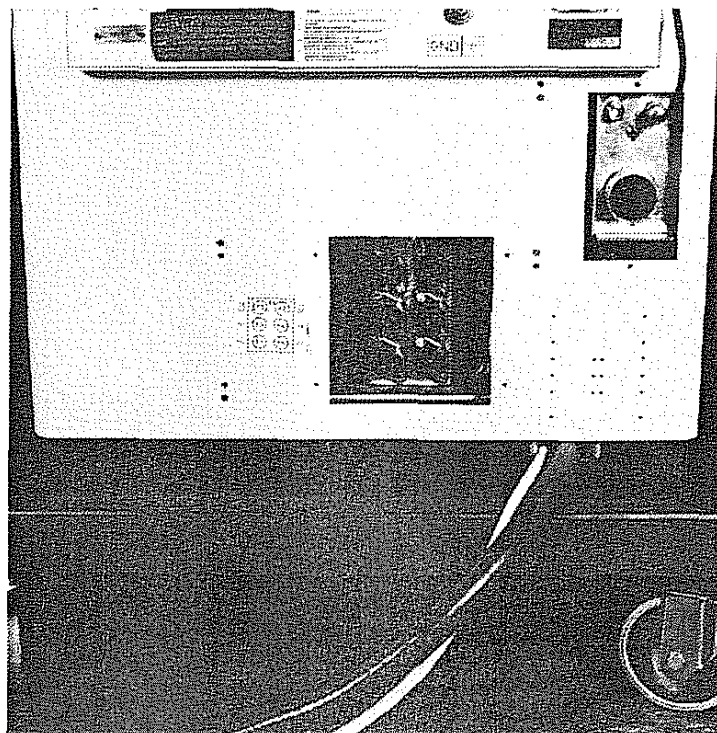
2) Connection of mains, video and remote cable plugs at rear of TV-monitor.



3) Wire settings of mains cable for TV-monitors and video memories in socket WAX1, and wires for 220V and 594 VAC to the stand in socket WAX2.



Programming the mains input voltage at terminal block WA100.



Fuses F1-F6 can be replaced when the lid is removed.

Section C:
Setting to work

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1. INTRODUCTION

This section describes the setting-to-work procedure and the control, adjustments and test facilities for the BV25.

2. TEST EQUIPMENT REQUIRED

6" BV25 test phantom - code number 4522 126 25150.

3. SETTING UP AND TESTING

The BV25 is factory adjusted and tested.

It is programmed for 220V/50Hz IEC or 110V/60 Hz IEC.

After installation and mains voltage and frequency programming according to section B, the BV25 can be prepared for the functional test.

3.1. SETTING TO WORK

- (1) Connect the mains input plug to the mains supply wall socket.
For mains resistance, see A-5.3.
The mains control unit WA is now energized.
This is indicated by LED H1 on the switch-on circuit WA1, in the mains control unit.
- (2) Open righthand side cover of the trolley. Release the fixing screws from the disk unit in the Digital Scopofix MDPM.
- (3) Switch system on by the power-on button on the control panel.
- (4) Switch TV monitor(s) on.
- (5) Perform the X-ray tube warm up procedure, see section F 4.2

3.2. FUNCTIONAL TEST

After system switch-on the starting situation is as follows:

- 'power-on' lamp is lighting
- automatic fluoroscopy lamp is lighting
- fluoroscopy kV-mA display shows 40 kV-0.1 mA.
- fluoroscopy time display shows 00.0 minutes
- If Scopofix installed, the image video memory is also switched on.
- The iris of the diaphragm is open at Ø 15 cm, the shutters are open at a slit width of 16 cm (measured at the I.I. entrance plane), and the slit is set perpendicular at the longitudinal direction of the diaphragm.
- The TV monitor(s) is (are) switched on.

3.2.1. Checking the vertical movement of C-arm

- (1) Operate the C-arm up and down buttons on the control panel.
- (2) Check the up and downward movement for smooth running and for limits of travel by the end-microswitches.

3.2.2. Checking the horizontal movement of C-arm

(see CZ-2)

- (1) Release the brake handle for the longitudinal movement.
- (2) Check the horizontal C-arm movement for smooth running for- and backwards.
- (3) Lock the brake handle and check the brake.

3.2.3. Checking the rotating movement of C-arm

(see CZ-2)

- (1) Release the brake handle for the rotating movement.
- (2) Check the rotating movement in both directions up to mechanical stop.
- (3) Operate the metal knob at the C-arm to rotate the C-arm beyond the mechanical stop.
- (4) Put the C-arm again in the normal position and lock the brake handle and check the brake.

3.2.4. Checking the orbital movement of C-arm

(see CZ-2)

- (1) Release the brake handle for the orbital movement.
- (2) Check the C-arm for smooth running for- and backwards.
- (3) Check also the orbital movement with C-arm in horizontal position (C-arm 90° rotated).
- (4) Check the balance of the C-arm.
- (5) Lock the brake handle and check the brake.

3.2.5. Checking the scanning movement of C-arm

(see CZ-2)

- (1) Release the brake handle for the scanning movement.
- (2) Check the scanning movement in both directions up to mechanical stop.
- (3) Lock the brake handle and check the brake.

NOTE:

In all C-arm positions the C-arm cable should have enough play to follow the C-arm movement.

3.2.6. Checking fluoroscopy

- (1) Press the reset button of the fluoroscopy timer (00.0 minutes).
- (2) Start fluoroscopy with handswitch or lefthand footswitch and check that the radiation-on lamp lights, and that after 4.8 minutes of fluoroscopy the bell lamp lights up and the buzzer sounds.
- (3) Press shortly fluoroscopy timer reset button and check that lamp and buzzer switch off and that the fluoroscopy timer still shows 4.8 minutes.
- (4) Fit 1.5 mm Cu plate on the collimator and start fluoroscopy in automatic mode.
- (5) Check that the kV/mA LED display shows about 60 kV-1.5 mA.
- (6) Switch over to manual fluoroscopy mode and check that the manual mode lamp lights up, and check the range of kV-value 40-105 kV, selected by +/- kV buttons.
- (7) Switch over to intermittent fluoroscopy mode and check intermittent fluoroscopy.
- (8) Fit a piece of metal on the II at the C-arm side.
Start automatic fluoroscopy and check that the piece of metal is displayed at the lower side of the picture.
Operate the scan-reverse horizontal button and check that left and right in the picture are reversed.
- (9) Operate the image-rotate-left button and check that the picture starts rotating to the left.
Operate the image-rotate-right button and check that the picture starts rotating to the right.
Operate both buttons at the same time and check picture for going to zero position.
Also check the image-rotate buttons on the TV monitor.
The complete picture should remain just visible during image rotation.
- (10) Start fluoroscopy and operate the iris +/- buttons and check the diaphragm adjustment on the monitor.
Operate the slit width and slit rotation buttons and check the slit width adjustment and its left-right rotation.

3.2.7. Checking radiography

- (1) Check that the cassette holder fits at the I.I. shield.
- (2) Operate the radiography mode button and check that the radiography mode lamp and "<15 format" lamp are lighting and that the diaphragm changes to the large focus position.
- (3) Operate the +/- kV buttons and +/- time buttons to check the kV range (40-100 kV) and the time range (0.2 - 80.0 mAs).
- (4) Make an exposure with the handswitch at 40 kV and 20 mAs and check that the radiation on lamp lights up and that the picture in the monitor circle stays clean.
- (5) Make another exposure and check that the exposure terminates when the handswitch is released.
- (6) Operate the 30- (15) and 40 (24) cm format buttons and check that the <15 cm format lamp switches off and the 30 (15) resp. 40 (24) cm format lamp switches on.

3.2.8. Checking Scopofix

The BV25 can be equipped with the following versions of Digital Scopofix video memories:

- Digital Scopofix MDP for 625/525 lines (double memory)
- Digital Scopofix MDPM for 625/525 lines (double memory + disc)

Digital Scopofix MDPM is equipped with a harddisc to store and retrieve 34 video images on disc.

After system switch-on, the video memory is blanked and lefthand TV monitor shows a black picture.

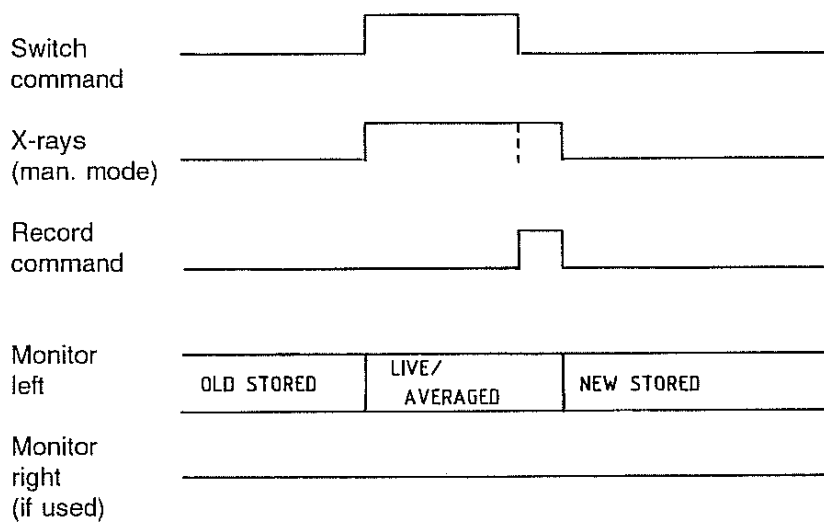
Check the functions of the memories, as described below.

STEP	CHECK FUNCTION	MEM.	USED
		MDP	MDPM
1	LIH at continuous fluoro	X	X
2	LIH at intermittent fluoro	X	X
3	SNAPSHOT function	X	X
4	FIX function	X	X
5	SUB function	X	X
6	COPY function		X
7	ERASE function		X
8	TRACKCOUNTER		X
9	PLAYBACK		X

(1) Last-image hold function at continuous fluoroscopy

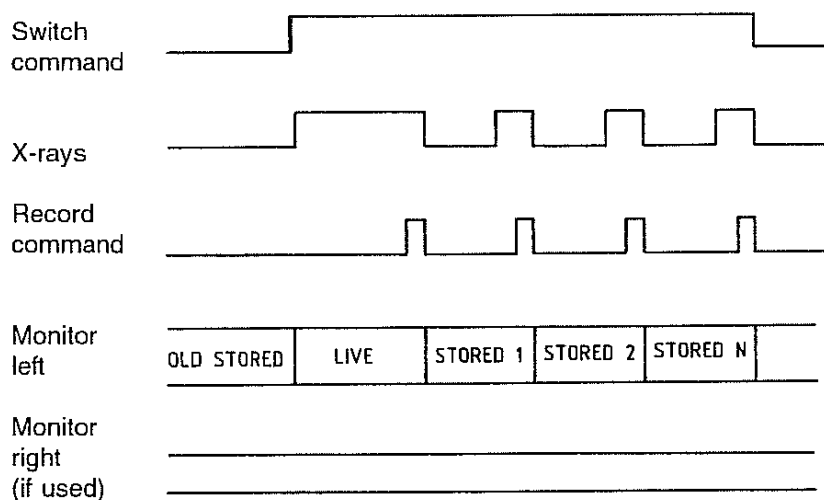
The image processing facility enables last-image hold recording with noise reduction. The TV monitor shows processed images during fluoroscopy.

- Operate automatic or manual mode button at control panel.
- Start fluoroscopy with handswitch or lefthand footswitch and check live/store command cycle for last image hold at TV monitor.



(2) Last-image hold at intermittent fluoroscopy

- Operate intermittent mode button at control panel.
- Start intermittent fluoroscopy in automatic mode or manual mode and check live-store command cycle for last-image hold on TV monitor.

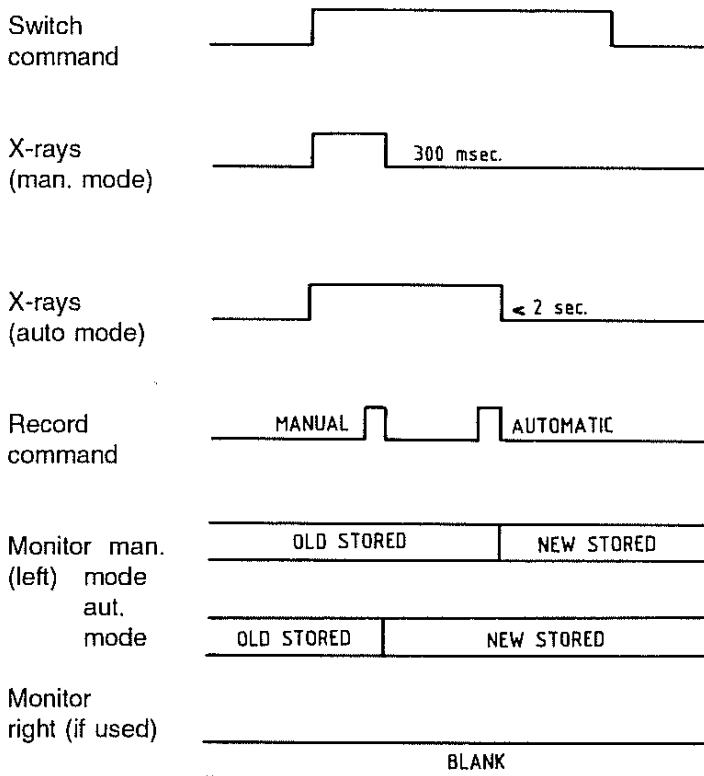


(3) Snap Shot function.

Snap shot recording will be done with noise reduction. A selected number of video frames ($n=16$) is integrated and after this integration a noise-reduced image is recorded and shown.

Snap shot can be switched off either by release of snap shot handswitch/righthand footswitch or by video-correct control back up timer of 2.0 seconds (automatic fluoroscopy or by timer of 300 msec. (manual fluoroscopy)).

- Operate snap shot handswitch or righthand footswitch in manual mode or automatic mode fluoroscopy and check store command for snap shot at TV monitor.
Keep footswitch depressed until the new stored image is shown on TV monitor.

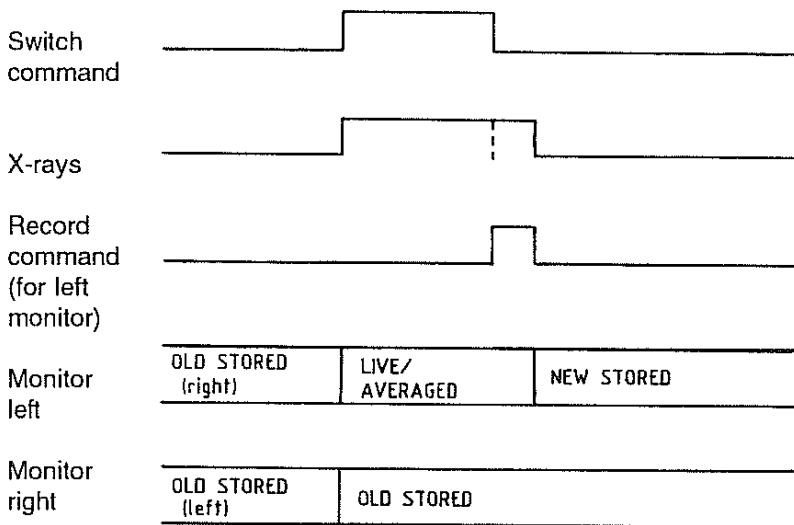


(4) FIX-function

When activating the FIX function, the picture on lefthand TV monitor is shown on righthand TV monitor and picture on righthand TV monitor is shown on lefthand TV monitor.

The lefthand TV monitor is always used for LIVE/LIH, snap shot or "disc" images, the righthand TV monitor is used for "FIX"ed images only.

- Operate FIX-button at control panel; FIX lamp on (pulse).
- Check TV monitors for exchange of images:
left hand image now shown at righthand monitor and righthand image now shown at lefthand monitor.
- Start automatic fluoroscopy with handswitch or lefthand footswitch and check live/averaged image -store command cycle for last-image hold at lefthand TV monitor and check righthand TV monitor for "fixed" image.
- Release FIX-button and check TV monitors again for exchange of images.



(5) SUB function

- Subtract function (with 2 TV monitors)
- Start fluoroscopy in automatic or manual mode (live/LIH or snapshot) for a mask-image on lefthand TV monitor.
- Press FIX button, the mask-image is shown on righthand TV monitor.
- Press SUB button to enter SUBTRACT mode.
- Start fluoroscopy in automatic or manual mode, the lefthand TV monitor shows subtracted mode. Upon release of hand- or footswitch the TV monitor still shows subtracted image.
- Press SUB button to release subtract mode.

NOTE

If one TV monitor is used, this monitor acts like the lefthand monitor, described above.

(6) COPY function

- Operate Copy button at control panel to copy the image shown on lefthand TV monitor to disc.
- Check that the trackcounter displays the next higher tracknumber.

(7) ERASE function (for Dig. Scopofix MDPM)

- Press button ERASE to erase the displayed image from disc.
- Trackcounter is incremented and the next image from disc is displayed on TV monitor.

NOTE:

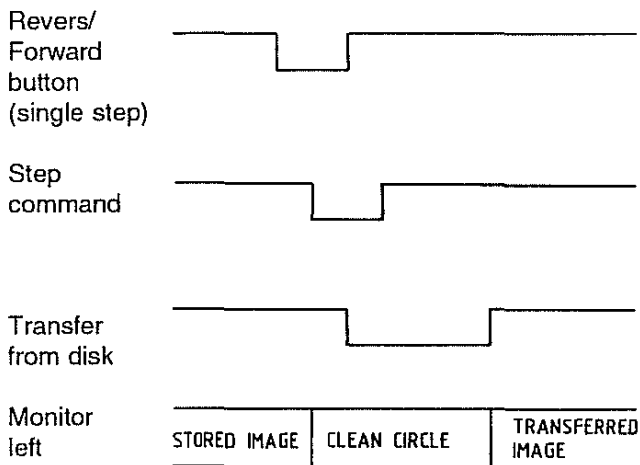
The ERASE function for Digital Scopofix MDPM is not protected against operation errors. A single depression of ERASE button immediately destroys the image from disc.

(8) Track counter

- Depress REVERSE button at front panel for count down to track number 000.
 - Depress FORWARD button at front panel for count up to track number 034.
 - Depress ZERO button at front panel and check that counter jumps to track number 000.
- Upon release of FORWARD or REVERSE button, the image of indicated track number will be displayed on TV monitor after a short time.
- At track number 000 a blank image is shown on TV monitor.

(9) PLAYBACK

- Operate REVERSE button at frontpanel to decrease trackcounter by one step.
- Check that trackcounter displays the next lower step.
- Check transfer from disc to memory, a blank image is shown on TV monitor.
- Check that at end of recording a transferred image is shown on TV monitor.



3.2.9. Checking stand alone operation mobile trolley

When BV25 system is equipped with a Scopofix MDPM version, the mobile trolley can be disconnected from the mobile stand and can operate stand alone for playback/display of video images stored on multi-image memories.

- Switch off system at control panel.
- Detach stand-trolley connection cable at mobile stand (SAX1).
- Attach plug of stand-trolley connection cable to connector WAX5 (behind small lid) at the rear of mobile trolley.
- Check that Scopofix and tv monitors are switched on.
- Operate forward/reverse buttons at front panel to playback stored images on TV monitor.

NOTE

The Mobile trolley has two video out BNC sockets at the rear (behind small lid) for connection of Video hard copy units.

4. CONTROLS AND INDICATORS

4.1. SYSTEM CONTROL PANEL

For a description of the buttons and indicators, refer to the operator's manual BV25.

4.2. SERVICE INDICATION CHECK

(see CZ-1)

Pressing the buttons "switch-on system" and "display error" at the same time activates the service indication check. All LCD displays and lamps are on.

4.3. ALARM & NOT-READY INDICATION

(see CZ-1)

The alarm and not-ready signals can be shown on LCD display as a code. If more alarm/not-ready signals are active, several code numbers may be displayed.

In case of an alarm both the indication ERROR and the code number flash. Also the power-on lamp starts flashing.

In case of a not-ready situation, the indications ERROR and code number are displayed, when the button "display error" (next to power-on button) is pressed.

For the description of the alarm/not ready signals, see following tables.

ALARM	MNEMONIC	MEANING
Error 1	HVGAL-H	H.V. alarm from I.I. cascade generator
Error 2	FILAL-H	Filament alarm from filament supply
Error 3	INVAL-H	Invertor alarm from DC power convertor
Error 4	MCUAL-H	Thyristor alarm from mains control unit
Error 5	TKTPAL-H	Tank temperature alarm from X-ray tank
Error 6	TIMAL-H	Timer alarm from exposure timer
Error 7	CLAL-H	600 Hz clock frequency alarm

NOT READY	MNEMONIC	MEANING
Error 1	HVRD-LC	High voltage for DC power convertor not ready
Error 2		Not used
Error 3	DIRD-LC	Diaphragm not ready
Error 4	SCBS-LC	Scopofix not ready
Error 5	SUPRD-LC	Power supply not ready
Error 6	GENRESHC	Not ready by general reset
Error 7	FLTMNR-HC	Not ready by 10-min fluoroscopy timer

4.4. ADJUSTMENT AND TEST FACILITIES

NOTE:

All voltages are measured with respect to 0 V.

4.4.1. GENERAL & ERROR PROCESSING BOARD SE13

MPS1: Practix-C tank temperature.

$V \leq 4.0 \text{ V}$: $48 < T < 50 \text{ }^{\circ}\text{C}$

$V \leq 2.4 \text{ V}$: $68 < T < 70 \text{ }^{\circ}\text{C}$

$V \leq 2.2 \text{ V}$: $T > 75 \text{ }^{\circ}\text{C}$

4.4.2. RADIOGRAPHY AND FLUOROSCOPY PROCESSING BOARD SE17

MPS1: to test the signal RQSTFL, request for fluoroscopy.

MPS2: to test the signal RADON, radiography on.

Potentiometer R1:

To adjust the interval time between two X-ray pulses during intermittent fluoroscopy.

4.4.3. X-RAY CONTROL BOARD SE19

MPS1: Value KVC, 4-10.5 V, corresponding to 40-105 kV.

MPS2: With jumper W3 in position 1-2:

Set value of the tube current.

With jumper W3 in position 1-3:

Tube current can be adjusted independent of kV value.

MPS3: Actual value of the tube current.

With jumper W1a in position 1-2:

0.1-9.0 V at fluoroscopy (0.1-3 mA).

With jumper W1b in position 4-5:

5.0 V at radiography (20 mA).

Potentiometer R1:

To adjust maximum DAC output for KVC to 10 V.

Potentiometer R2:

To adjust KVC to 10.5 V (French Homologation).

Potentiometer R3:

To adjust maximum DAC output for MAC to 9 V.

Potentiometer R4:

With jumper W3 in position 1-3: to adjust the tube current manually, independent from kV setting (dose rate adjustment).

4.4.4. DIAPHRAGM CONTROL 1 BOARD SE21

Potentiometer R1:

To adjust the iris reference field size of Ø 13 cm on the I.I. entrance plane when jumper W3 is in position 1-3.

4.4.5. DIAPHRAGM POTENTIOMETERS

Iris potentiometer LAR1:

To adjust manually the actual feedback voltage for an iris opening of 15 cm Ø on the I.I. entrance plane.

Slit width potentiometer LAR2:

To adjust manually the actual feedback voltage for a slit width of 16 cm on the I.I. entrance plane.

Slit rotation potentiometer LAR3:

To adjust manually the actual feedback voltage for 0° position of the slit in b-direction.

Focus position potentiometer LAR4:

To adjust manually the actual feedback voltage for the large and small focus position.

4.4.6. FILAMENT SUPPLY BOARD SE31

Testpoints MP6-7:

Vref: -10- 0 Volts depending on the setting of potentiometers R1, R2, R3, R60 in fluoroscopy and radiography mode.

Potentiometer R1:

To adjust the tube current for preheating in radiography mode (2 mA). R1 can vary Vref from -6.5 to -4.9 Volts. The 2 mA measurement is done on testpoints MPS3-MPS0V on X-ray control board SE19.

Potentiometer R2:

To adjust the tube current in radiography mode for 100 kV/20 mA; R2 can vary Vref from -6.0 to -4.2 Volts. The 20 mA measurement is done on testpoints MPS3-MPS0V on X-ray control board SE19.

Potentiometer R3:

To adjust the tube current in radiography mode for 40 kV/20 mA. R3 can vary Vref from -4.25 to -4.1 Volts, depending on signal KVC (+4- +10 Volts).

Potentiometer R60:

To adjust the tube current in radiography mode for French Homologation. (30 mA)

4.4.7. POWER CONTROL BOARD SE33

Testpoints X5-X6: X6: 0 V.

Voltage at X5 is the inverted value of voltage at X2:V, PWRSMDV; this is the feedback voltage of PWRSMD voltage on the power capacitor SEC1.

Testpoint X7:

To measure the HV command signal.

Testpoint X4:

To measure the triggerpuls.

Potentiometer R1:

Factory-adjusted for the correct voltage- to frequency conversion.

Potentiometer R116:

To adjust the voltage across the terminals of power capacitor SEC1 in accordance with the displayed kV value, e.g. 100 kV.

4.4.8. INVERTOR POWER 1 BOARD SE37

Testpoint + PRHV / - PRHV: to measure reference voltage for primary high tension.

Jumper test: inverter alarm service jumper.

4.4.9. CONTROL BACKPANEL SE10

The control backpanel has test points to bridge the p.c.b. keys of XTV8S unit, Scopofix control unit WHA1 motor unit SM, power backpanel SE30 and System Control Panel SB.

4.4.10. POWER BACKPANEL SE30

Testpoints:

SE30: 11-12-13-14-15-25-26-27-30-31 PWRGND. These are the ground terminals for the H.V. converter and the Practix C tank.

SE30: 16-17 ACHVT1-2. These are the high voltage terminals (140-380 Volts, 300 Hz) for the primary side of the H.V. transformer in the tank.

SE30: 22-23 AC600VF1-F2. These are the input a.c. voltage terminals (600 Volts, 50 Hz) for the H.V. converter.

SE30: 24 PWRS. This is the d.c. voltage terminal (140- 380 Volts d.c.) at the smoothing capacitor SEC1.

SE30: X21 PWR. This is the power voltage terminal from rectifier (Power not yet smoothed by capacitor SEC1).

4.4.11. SCOPOFIX BOARD WHA1

- R8 : Gain adjustment of the video input amplifier for the live video signal.
Factory set to a gain of 2x.
- R19 : Brightness adjustment of the memory indication bars for memory 2 (NOT USED).
- R20 : Brightness of the memory indication bars for memory 1 (NOT USED).
- R48 : Gain adjustment of the video input amplifier for memory 1. Factory set to a gain 2x.
- R58 : Gain adjustment of the video input amplifier for memory 2. Factory set to a gain 2x.
- R78 : Gain adjustment of the video output amplifier for the left monitor.
Factory set to a gain of 3x.
- R118 : Gain adjustment of the video output amplifier for the right monitor.
Factory set to a gain of 2x.
- R144 : Positioning the left memory indication bar at 1 cm distance of monitor circle (factory set).
- R146 : Positioning the right memory indication bar at 1 cm distance of monitor circle (factory set).

4.4.12. MECHANICAL ADJUSTMENTS

The following adjustments can be done in the field:

- Adjustment of the C-arm bearings for the orbital movement.
- Adjustment of the brake disc for the C-arm rotation.
- Adjustment of the brake for orbital movement of C- arm.

4.4.13. 15 CM H.T. II CASCADE GENERATOR

MP2-MP3:

Cathode Voltage; $V_{\text{cath}} = 5000 * V_{\text{mp2-3}}$

MP4-MP1:

Focusing voltage; $V_{\text{foc.}} = 33 * V_{\text{mp4-1}}$

Potmeter BGR1:

Control voltage to adjust cathode voltage.

Potmeter BGR2:

Control voltage to adjust focusing voltage.

Refer to service manual of II cascade generator for adjustments.

4.4.14. 43 CM TV MONITOR

Refer to the service manual of TV monitor for adjustments.

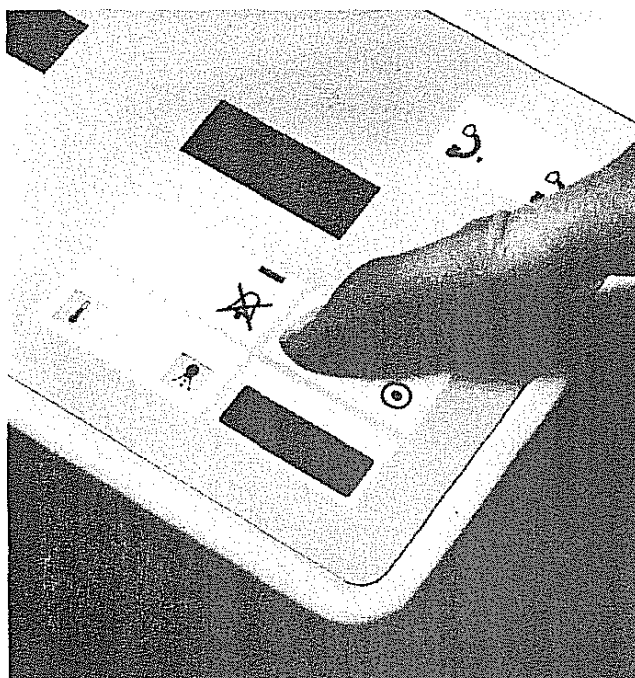
4.4.15. TV CHAIN XTV8S

Refer to service manuals of XTV8S camera control unit and camera for adjustments of WN/WK boards.

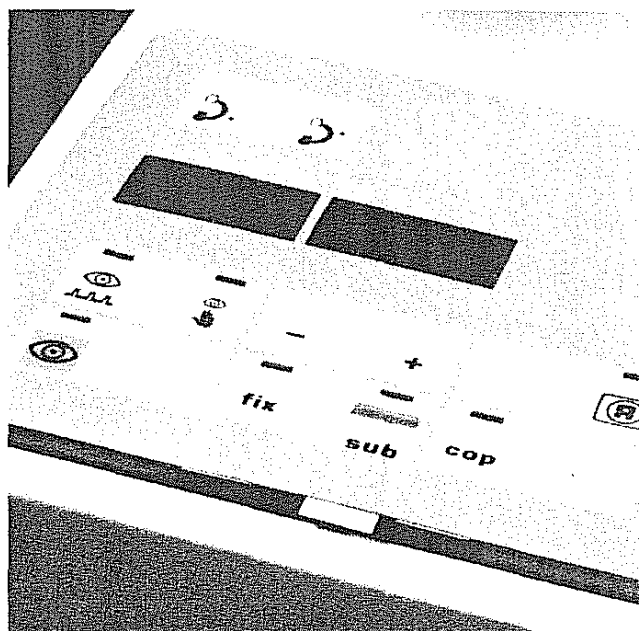
4.4.16. SCOPOFIX VIDEO MEMORIES

Refer to the service manual of Digital Scopofix for adjustments.

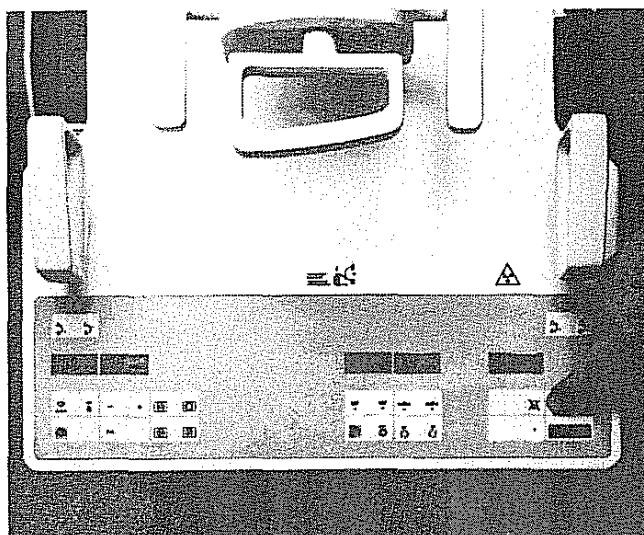
5. ILLUSTRATIONS



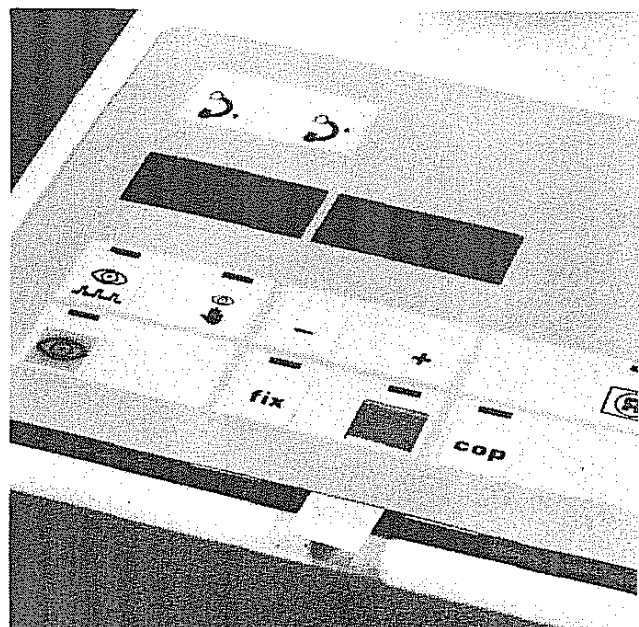
- 1) Pressing the button "display error" activates the alarm & not ready indication circuit. Indicates "ERROR" and error code number 1...9 are displayed on LCD display.



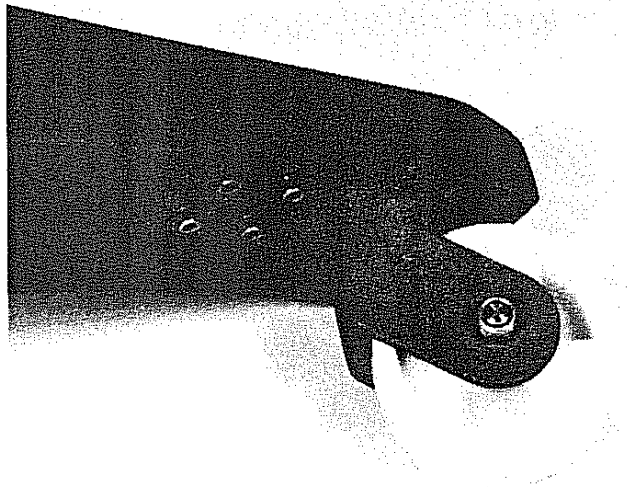
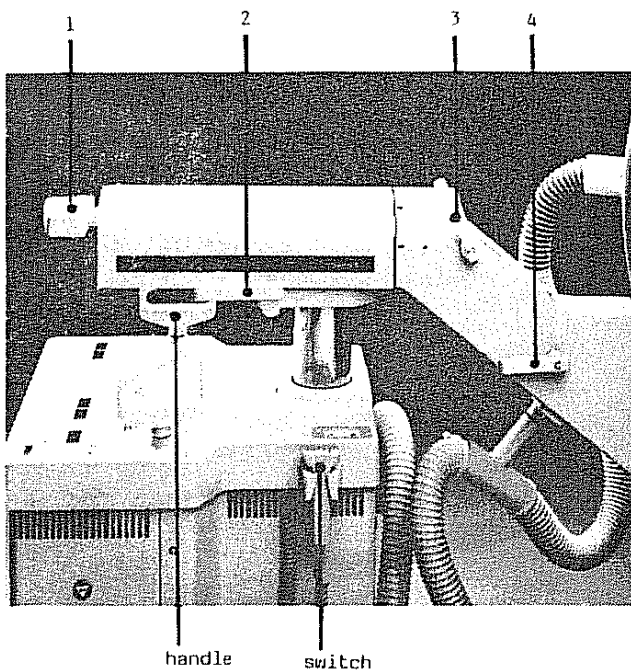
- 3) Changeable legends for functions 'FIX', 'SUB', 'CI' and for cassette sizes $\phi 15$ cm, $\phi 24$ cm (HHS) and $\phi 30$ cm and $\phi 40$ cm (IEC). The legends are slid into the system control panel. To lift the panel, loosen special screws at the bottom of panel.



- 2) Pressing the buttons "power on" and "display error" activates the service check. All LCD indicators and lamps are on.



- 4) Slide the legends with blank side up to cover the indication lamp if a function is not used.

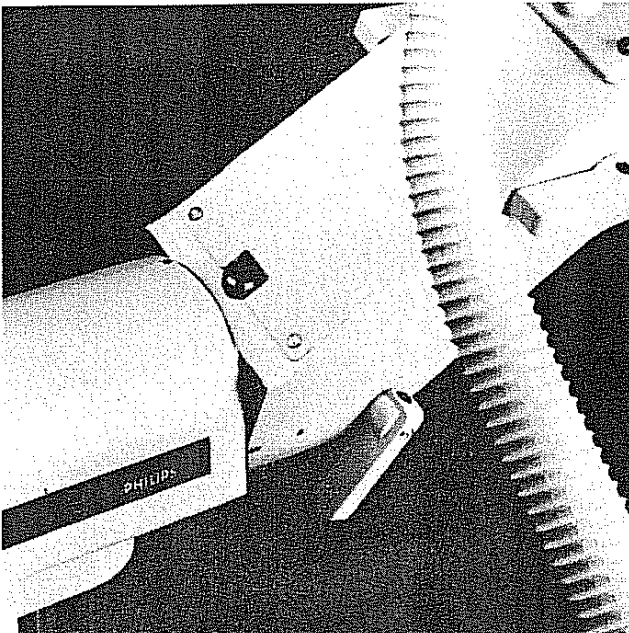


3) Steerable nose wheel of stand.

1) Brake handles for C-arm positioning:

1. Horizontal movement
2. Scanning movement
3. Rotating movement
4. Orbital movement

The handle is used for steerable nose wheel
The switch is used to give X-ray generation



- 2) Mechanical stop for rotational movement of C-arm (155°). Pressing the metal knob will enable the C-arm to rotate beyond 155° .

Section F:

Corrective maintenance

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Warning

** IN CASE OF REPLACEMENT OF CERTIFIABLE ITEMS ALWAYS REPLACE DUPLICATE LABEL ON CENTRAL LABELLING STATION.*

1. INTRODUCTION

This section contains diagnostic procedures and adjustment and replacement procedures.

A what-to-matrix which indicates what to do at replacement of parts, is given below:

REPLACEMENT OF PARTS	REPLAC. PROC	ADJUST. PROC	SETTINGS
PCB SE19:X-ray control		F4.	SE19:R1,R2,R3 SE19:MPS1: 10.0V \approx 100 kV SE19:MPS1: 10.5 V \approx 105 kV French Homologation SE19:MPS2: 9.0 V \approx 3.0 mA SE19:MPS3: 0.3-9.0V \approx 0.1-3.0 mA fluoroscopy
PCB SE31: Filament supply		F4.	SE31:R1 (20 turns) midposition SE31:R2,R2,R60 (20 turns) CCW SE19:MPS3: 5.0 V. \approx 20 mA exposure SE19:MPS3: 7.5 V. \approx 30 mA French Homologation
PCB SE33: Power control		F4.	SE33:R116 SEC1: 346 V \pm 2V \approx 100 kV
PCB WHA1:Video routing		F7.	Gain adjustment of video routing
Practix-C tank	F5.	F4. F4. F4. F7.	X-ray tube warm up procedure SE19:MPS3: 0.3-9.0 V. \approx 0.1-3.0 mA fluoro SE31:R1 (20 turns) midposition SE31:R2,R2,R60 (20 turns) CCW SE19:MPS3: 5.0 V. \approx 20 mA exposure SE19:MPS3: 7.5 V. \approx 30 mA exp. French Homologation Alignment tank/diaphragm
Diaphragm	F8.	F7.	Alignment tank/diaphragm
XTV8		F5.	II/TV adjustments
I.I. tube	F8.	F7. F5.	Alignment tank/diaphragm II/TV adjustments
HT generator for I.I.	F8.	F8.	II/TV adjustments
Motor vertical movement	F8.	F7.	Adjustment V-belt for vertical movement

Warning

- Before making any exposure, ensure that all radiation safety precautions have been observed.
- Maintain maximum distance from X-ray beam as far as practical.
- Hang protective aprons around I.I. housing to shield X-ray beam area and rotate C-arm over 30 degrees out of vertical position.

2. TOOLS AND TEST EQUIPMENT

Standard toolset
Multimeter
Oscilloscope
X-ray photometer
Extender boards
Test phantom (Funk phantom)

3. DIAGNOSTIC PROCEDURES

Since BV25 is equipped with XTV8, the flowchart of the BV25 Family E/N/HR will be updated. This flowchart will be issued later.

4. ADJUSTMENT PROCEDURES

4.1. ADJUSTMENT PROCEDURE X-RAY TUBE CURRENT

This procedure must be done at replacement of:

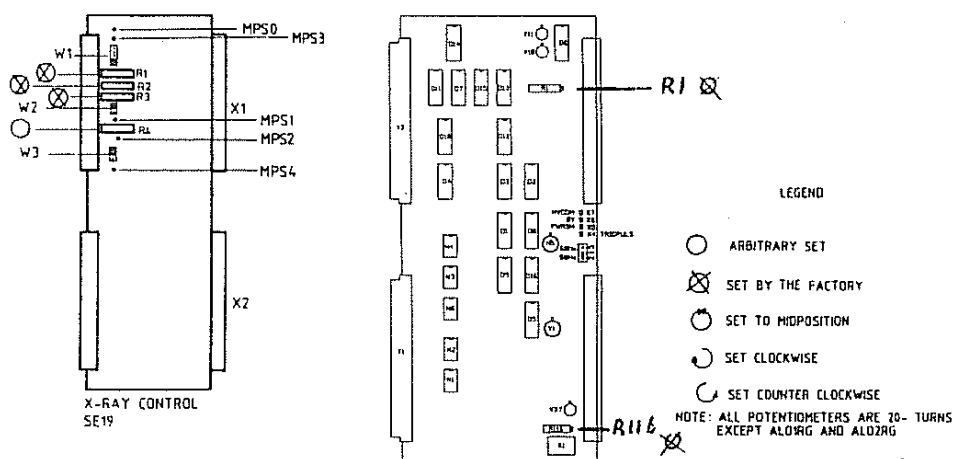
- Practix-C tank
- p.c.b. SE19 X-ray control
- p.c.b. SE31 filament supply
- p.c.b. SE33 fet power control

In case of replacement of SE19, check settings of jumpers:

- W1 in position 1-3 (mA fluo)
- W2 in position 1-2 (normal)
- W3 in position 1-2 (control)

4.1.1. For fluoroscopy

STEP	ACTION	CONNECT MULTIMETER TO	READ MULTIMETER	ADJUST BY
1	Select manual fluoroscopy			
2	Set 100 kV			
3	Check KVC voltage	SE19:MPS1-MPS0	10.00 +/- 0.01 V.	SE19:R1
4	Check Iref	SE19:MPS2-MPS0	9.00 +/- 0.01 V.	SE19:R3
5	Check PWRSM	Terminals of SEC1	346 +/- 2 V.	SE33:R116
6	Operate handswitch	9.0 V. +/- 10%		
7	Set 40 kV			
8	Operate handswitch	0.3 V. +/- 10%		



4.1.2. For radiography

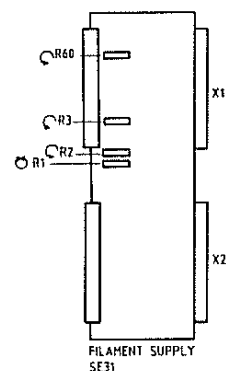
Warning

Wait 2 minutes after each exposure because of high load.

NOTE

If you use an oscilloscope instead of a multimeter, the exposure time can be reduced, thus reducing the load of X-ray tube. (e.g. 10 mAs)

STEP	ACTION	CONNECT MULTIMETER TO	READ MULTIMETER	ADJUST BY
1	Switch off BV25			
2	Set jumper SE19:W1 in pos RAD			
3	Set potmeter SE31:R1 (20 turns) in midposition			
4	Set potmeters SE31:R2,R3,R60 <u>fully counter clockwise</u>			
5	Switch on BV25, select radiography and set 80 kV, 80 mAs			
6	Operate handswitch	SE19:MPS3-MPS0	0.5 V. +/- 5%	SE31:R1
7	Operate handswitch		4.7 V. (roughly)	SE31:R2
	WAIT 2 MINUTES AFTER HEAVY EXPOSURE			
8	Set 100 kV, 80 mAs			
9	Operate handswitch		5.0 V. +/- 5%	SE31:R2
10	Set 40 kV, 80 mAs			
11	Operate handswitch		5.0 V. +/- 5%	SE31:R3
12	Set jumper SE19:W2 in pos FRN (French homologation)			
13	Set 105 kV, 9.6 mAs			
14	Check KVC voltage	SE19:MPS1-MPS0	10.5 V. +/- 0.01 V.	SE19:R2
15	Operate handswitch	SE19:MPS3-MPS0	7.5 V. +/- 5%	SE31:R60
16	Reset jumpers : SE19:W1 in pos FLUD SE19:W2 in pos STD (Standard)			



4.2. X-RAY TUBE WARM-UP PROCEDURE

Perform this procedure when:

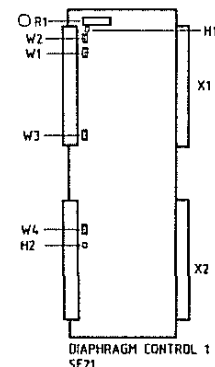
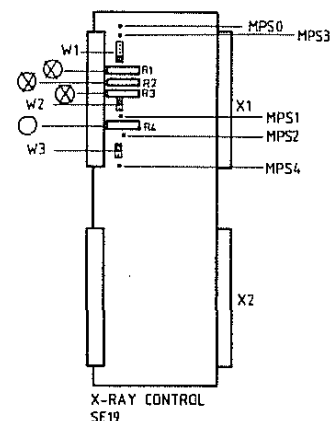
- A tube is replaced
- The system was out of use for a long time
- X-ray tube arcs too much (more than 3 times per day)

NOTE

If X-ray tube does not function properly during warm-up procedure, switch off system. Start again at 10 kV lower. If X-ray tube, after 3 times, fails to complete the procedure, a new tube is recommended.

- (1) Put a lead plate over X-ray tank to prevent damage of camera tube.
- (2) Switch on system, and select manual fluoroscopy at 40 kV at LCD display.
- (3) Connect a multimeter to SE19: MPS3-MPS0 to check tube current signal (coupling kV-mA).
- (4) Perform fluoroscopy as per table below, and check multimeter readings.

kV VALUE	TIME	READ MULTIMETER
40 kV	30 seconds	0.3 Volt
50 kV	30 seconds	0.9 Volt
60 kV	30 seconds	4.5 Volt
70 kV	30 seconds	8.1 Volt
PAUSE	60 seconds	
80 kV	30 seconds	8.4 Volt
PAUSE	120 seconds	
90 kV	30 seconds	8.7 Volt
PAUSE	120 seconds	
100 kV	30 seconds	9.0 V.
PAUSE	120 seconds	
100 kV	90 seconds	9.0 V.
PAUSE	120 seconds	



- (5) Set SE21:W4 in position 1-3; Led H2 on (large focus selected).
- (6) Set 80 kV at LCD display.
- (7) Operate hand/footswitch for 90 seconds.
- (8) Reset SE21:W4 in position 1-2.

5. DOSE-RATE ADJUSTMENT

NOTE

For dose-rate adjustment perform following procedures in sequence as mentioned below!!

5.1. PRESETTINGS

See drawing Z3-1 XTV8-SRI doc. for the location of the jumpers, switches and potentiometers.

Carry out/check the following settings:

- jumper WK4 W1:2-3 (clean circle off)
- switch WK4 S2-6: on (max. VIBS = 1100 mV)
- jumper WK4 X19:B2-3 (cable comp. 0-3.3m)
- jumper WK3 W1:1-2 (block gen. on) and turn WK3:P1 clock wise (amplitude = 0V)
- measure with a oscilloscope on WK3:MP7 VIBS (0V = WK4:MP1 or MP2), trigger external on the midline WK5:MP1
- adjust the black level with WK3:P4 to 45mV
- measure on WK3: MP1/MP14 VIN and adjust the blockgen. with WK3:P1 to 250mV

5.2. VIDEO GAIN

- set: WK3 W2:1-2 (rampgenerator on)
- WK4 S2-4: off (white compression curve 2)
- measure VIBS WK3:MP7 and adjust the top of the video to 1100 mV with WK5:P1 see fig. 1
- set: WK3 W2:2-3 (rampgenerator off)
- WK4 S2-4: on (white compression curve 1)
- adjust the black level once more with WK3:P4 to 45mV
- measure on WK3:MP1 / MP14 VIN and adjust the block gen. with WK3:P1 to 250 mV.

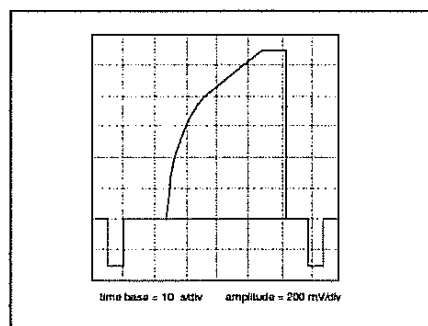


Figure 1, max. video level

5.3. AGC THRESHOLD SMALL MF

- set: WK4 S3-6: off (MF local selectable)
- WK4 S3-7: off (small MF selected)
- measure VIBS WK3:MP7 and adjust the threshold to 400 mV with WK3:P6

5.4. AGC THRESHOLD LARGE MF

- set: WK4 S3-7: on (large MF selected)
- measure VIBS WK3:MP7 and adjust the threshold to 400 mV with WK3:P7

5.5. BLACK LEVEL ADJUSTMENT

- set WK3 W1:2-3 (block gen. off)
- measure the signal on VIBS WK3:MP7 and adjust the black level to 45 mV with WK3:P4

Put the jumper/switch setting back to its original position (check section 5 XTV8-SRI doc, Programmings)

- jumper WK4 W1:1-2 (cleancircle on)
- switch WK4 S2-6 (max. VIBS, monitor depended see section 5 XTV8-SRI doc, Programmings)
- switch WK4 S3-6: on (MF remote selectable)
- WK4 S2-5 : off (Fixed gain off)

5.6. DOSERATE ADJUSTMENT

NOTE

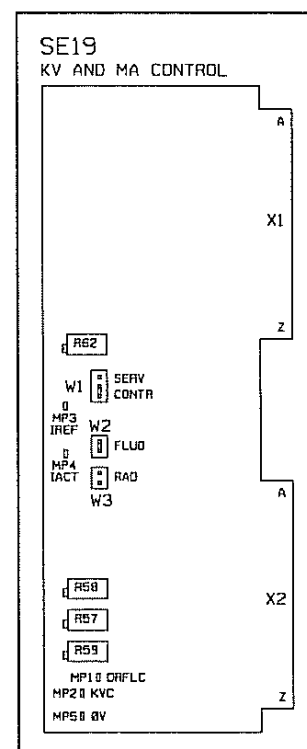
ALLOW THE X-RAY PHOTOMETER TO WARM UP FOR AT LEAST ONE HOUR BEFORE PERFORMING THIS PROCEDURE.

- Remove grid from II-shield.
- Put the 1.5 mm Cu plate on top of the X-Ray diaphragm.
- Put the probe of the X-Ray photometer as close as possible to the entrance plane of the II-tube. Position of probe: in the centre of the II-tube.
- Select "uR/sec" readout of X-Ray photometer.
- Calibrate X-Ray photometer so that readout indicates zero.
- Put jumper SE19:W1 in position: SERV. (= manual mA control).
- Select the largest II-format.
- Initiate fluoroscopy manual mode.
- Set manually 75 kV.
- Adjust the entrance dose to:

25 uR/sec for the 15 cm II-format,
(0.22 uG/sec).

by varying the mA value with potentiometer: SE19:R62.

- Stop fluoro, remove the X-Ray photometer probe.

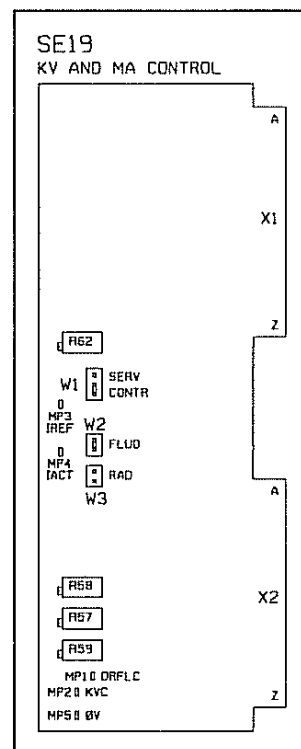


- Connect the oscilloscope to testpoint: SE19:MP1 DRFLC.
Use probe 1:10.
- Carry out fluoroscopy
- Adjust this DRFLC signal with potentiometer WK6:P1, located on the XTV-8SRI camera to:
0 V +/- 100 mV.
- Stop fluoroscopy.
- Put back jumper SE19:W1 to CONTR.

6. HIGH DOSE-RATE IN HIGH-DEFINITION FLUOROSCOPY MODE

The dose-rate in HIGH-DEFINITION FLUO mode is a factor 2.4 higher than during normal fluoroscopy.

The factor 2.4 is a FIXED factor and CANNOT be adjusted.



7. FIXED GAIN ADJUSTMENT

7.1. INTRODUCTION

Check first:
Procedure "AGC-THRESHOLD".

7.2. PROCEDURE

- Remove grid from II-shield.
- Put the 1.5 mm Cu plate on top of the X-Ray diaphragm.
- Check if jumper SE17: W1 is in position FIX.
- Connect an oscilloscope to testpoint: WK3:MP7 (VIBS).
- Initiate fluoroscopy in automatic mode.
- Measure the VIBS signal.
- Switch over to manual fluoroscopy.
- Initiate fluoroscopy.
- Adjust the VIBS signal with potentiometer WK3:P5 (FIXED GAIN), so that the measured signal during manual mode is equal to automatic mode.
- Put back grid.

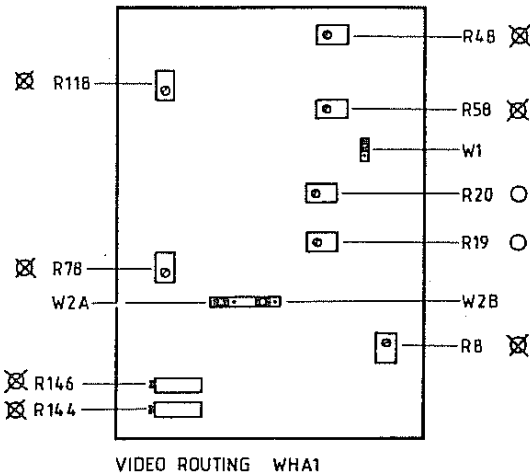
4.4. GAIN ADJUSTMENT OF VIDEO ROUTING

- (1) Measure with oscilloscope the amplitudes of video input and output signals on video routing board WHA1
- (2) Adjust gain of various routings on board WHA1 to equalize amplitudes of video input and output in order given below.

NOTE

The video output must be terminated with 75 ohms.
Use a TEE adapter to connect oscilloscope to TV-monitor or Digital Scopofix, so having a 75 ohms termination.

ST EP	CONDITIONS	CHANNELS OF OSCILLOSCOPE CONNECTED TO:		ADJUST BY
		Channel A	Channel B	
1	Set jumper WHA1:W1 in pos 1-2, 2 monitors			
2	Start fluoroscopy	VIBS	OUT1	WHA1:R8
3	Set switch WTS1 (rear trolley) in pos. MEM OFF			
4	Start fluoroscopy	VIBS	MON-L	WHA1:R78
5	Stop fluoroscopy	INMEM1	MON-L	WHA1:R48
6	Press FIX button	INMEM2	MON-L	WHA1:R58
7	Press FIX button	INMEM2	MON-R	WHA1:R118



7.4. ALIGNMENT PROCEDURE DIAPHRAGM UNIT WITH RESPECT TO PRACTIX-C TANK AND IMAGE INTENSIFIER

This procedure must be done at replacement of Practix-C tank, diaphragm unit or motor/potentiometers of diaphragm unit.

After the alignments, the centres of Practix-C tank, diaphragm and image intensifier are matched.

The procedure deals with the following adjustments:

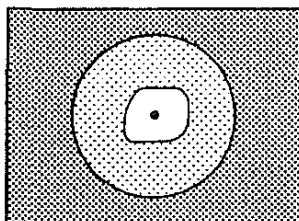
- (1) Alignment of "focus-near" ring with respect to Practix-C tank.
- (2) Alignment of shutters with respect to Practix-C tank.
- (3) Alignment of iris diaphragm with respect to Practix-C tank.

For the positions of iris diaphragm, shutters and focus-near ring, see FZ-2.

- Operate C-arm up button for easily working position of diaphragm unit.

(1) Alignment of focus-near ring.

- Switch off the system and remove diaphragm cover.
- Remove iris diaphragm and shutter units from mounting bracket.
- Connect pin MPD1 to MPD2 on SE10 (control backpanel) to activate the signal Diaphragm Ready (DIRD).
- Use brass disk delivered with the system, and place this alignment tool inside the focus-near ring. Turn the four fixing screws in the ring finger tight, so it can be moved easily.
- Position jumper SE21: W4 in 1-3 to select large focus. Move the spot of large focus on TV monitor to the centre of II entrance plane (washer), by shifting the focus-near ring. (Figure F4.5.2)
- Tighten the four fixing screws and check if the spot is still in the centre of I.I. entrance plane. Readjust if necessary.
- Remove the alignment tool. Reposition jumper SE21:W4 in 1-2.



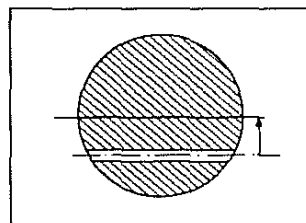
F4.5.2

(2) Alignment of shutter unit.

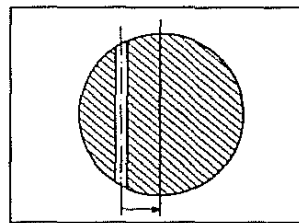
Caution

Be sure that small focus has been selected before starting this alignment. (SE21:W4 in 1-2).

- Fit the shutter unit on mounting bracket and turn the free fixing-screws finger tight.
- Operate button to close shutters for smallest slitwidth, and operate button to rotate slit in B-direction. During fluoroscopy, a horizontal slit is visible on TV monitor. Position the slit in the horizontal centre line of TV monitor circle by shifting the unit. (Figure F4.5.3)
- Operate button to rotate slit in A-direction. During fluoroscopy, a vertical slit is visible on TV monitor. Position the slit in the vertical centre line of TV monitor circle by shifting the unit. (Figure F4.5.4). Tighten the three fixing screws. Check if the slit remains in the centre lines of TV monitor when rotating the slit unit. Readjust if necessary.



F4.5.3

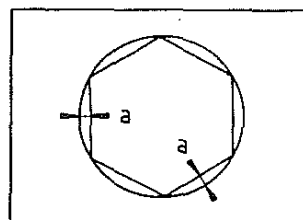


F4.5.4

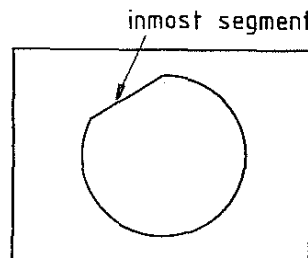
(3) Alignment of iris diaphragm

To center the iris diaphragm in the monitor circle, proceed as follows:

- Fit iris diaphragm unit on mounting bracket and turn nuts finger tight. Connect cable LAX1 and remove connection between SE10:MPD1 and MPD2.
- During fluoroscopy, operate iris - button until iris is visible on TV monitor. Center the iris in TV monitor circle, the corners of iris are just inscribed in the circle. The diaphragm unit can be shifted by putting a screwdriver through the alignment hole, using it as joystick (see FZ-2).
- Tighten the three nuts of diaphragm unit. Check for a centered picture of iris on TV monitor and readjust if necessary.



F4.5.5



F4.5.6

To adjust the reference iris field size, proceed as follows:

- Operate iris - button to make iris visible.
- Adjust iris size slightly by potentiometer SE21:R1.
- Operate iris + button to set the iris just outside monitor circle. Repeat the 3 former steps until the iris is just outside monitor circle when fully opened.
- Switch over to radiography mode with format Ø 40 and switch back to fluoroscopy mode.
- Check that iris diaphragm is not visible in TV monitor circle. If not o.k., repeat reference iris field size adjustment.

4.6. ADJUSTMENT DIAPHRAGM POTENTIOMETERS

- (1) Put the C-arm in the upright position with the Practix C tank/diaphragm down and lock the C-arm.
- (2) Remove diaphragm cover with spacer.

Iris field size potentiometer LAR1

- (3) Connect a multimeter to terminals LAX1:4 and LAX1:2 (0 V) to measure the FSPO signal of LAR1 (field size).
- (4) Select fluoroscopy mode and operate iris buttons for maximum field size, the multimeter should read 3700 mV \pm 50 mV. Readjust with SE21:R1 if necessary.
- (5) The iris diaphragm opening must be set to 21.9 mm measured at upper segments of iris, giving a field size of \emptyset 150 mm at the I.I. entrance plane. For adjustment, loosen screws for clamp plates of potentiometer LAR1 a bit and turn manually the potentiometer
- (6) Tighten screws of clamp plates after adjustment and check opening of iris diaphragm again.

NOTE

When the field size at I.I. entrance plane is \emptyset 5 cm, the feed-back voltage of the iris potentiometer LAR1 is about 1.8 Volts.

When the field size at I.I. entrance plane is \emptyset 15 cm, the feed-back voltage of the iris potentiometer LAR1 is about 3.7 Volts.

Shutter field size potentiometer LAR2

- (7) Switch over to fluoroscopy mode and operate shutter buttons for minimum opening
- (8) Operate shutter buttons for maximum opening (dead band of shutters)
- (9) The shutter opening must be set to \emptyset 12.1 mm giving a field size of \emptyset 160 mm at the I.I. entrance plane. For adjustment, loosen screws for clamp plates of potentiometer LAR2 a bit and turn manually the potentiometer
- (10) Tighten screws for clamp plates after adjustment and check opening of shutters again.

NOTE

When the shutter is fully opened, the feed-back voltage of the shutter potentiometer LAR2 is about 5.0 Volts.

When the shutter is fully closed, the feed-back voltage of the shutter potentiometer LAR2 is about 1.8 Volts.

Shutter rotate potentiometer LAR3

- (11) Switch over to fluoroscopy mode and operate shutter buttons for minimum opening
- (12) The opening of shutters must be set perpendicular at the longitudinal direction of the shutter carriage. For adjustment, loosen screws for clamp plates of potentiometer LAR3 a bit and turn manually the potentiometer
- (13) Tighten screws for clamp plates after adjustment and check direction of shutters again.

Focus position potentiometer LAR4

- (14) Connect multimeter to terminals LAX1:5 and LAX1:2 (0 V) to measure the FPPO signal of LAR4 (focus position).
- (15) Switch to radiography mode, the carriage of iris diaphragm is moved close to the C-arm side.
- (16) Loosen screws for clamp plates of potentiometer LAR4 a bit, and turn manually the potentiometer to move the carriage as close as possible to the C-arm side (large dead band).
- (17) Tighten screws of clamp plates after adjustments

NOTE

When the diaphragm carriage is at the small focus position for fluoroscopy, the feed-back voltage of the focus position potentiometer LAR4 is about 7.6 Volts.

When the diaphragm carriage is at the large focus position for radiography, the feed-back voltage is about 2.3 Volts.

- (18) Check diaphragm-not-ready error at LCD display error 3 is indicated when button "Display Error" is depressed). It is off, when next conditions are all fulfilled:

- after change of focus position
- fieldsize of iris $\leq \emptyset$ 15 cm in fluoroscopy mode
- after change of iris field size to IEC formats (30 and 40 cm) in radiographic mode

4.7. ADJUSTMENT C-ARM BALL BEARINGS IN SLIDE BLOCK

(see FZ-3)

To adjust the C-arm ball bearings to the C-arm surface for a smooth sliding movement, proceed as follows:

- (1) Position C-arm with I.I. up and rotate C-arm over 90° to put C-arm horizontally.
 - (2) Remove lower cover plate of slide block (4x screw 3 and 2x screw M5).
 - (3) At each side of C-arm, two sets of ball bearings have been mounted on a mounting plate, each as a set of two. Loosen locking screw of eccentric. Push one ball bearing against C-arm surface by adjusting the eccentric, adjust clearance between the other ball bearing and C-arm surface to 0.5 mm
- tighten locking screw, and repeat adjustment for the other set of ball bearings.
- (4) Rotate C-arm over 180°, so the other side of C-arm comes up.
 - (5) Repeat adjustment of ball bearings, and check for a smooth running of C-arm.
 - (6) Replace cover plate of slide block.

4.8. ADJUSTMENT BRAKE C-ARM ROTATION

If the moment of braking force is smaller than 45 Nm, the brake can be adjusted as follows:

- (1) Remove cover plate of sliding block (3x screw M3) and release brake handle C-arm rotation.
- (2) Remove the two locking screws in inner brake ring (socket screws M3, see FZ-3).
- (3) Unscrew the brake ring manually until it hits the eccentric.
- (4) Replace the two locking screws and tighten them there are six holes for easily positioning of screws).
- (5) Lock the brake handle. Adjust the horizontal position of brake handle by adjusting the set screw on bracket.
- (6) If adjustment has not been sufficient, the brake disc should be replaced. See replacement procedure, section F-5.7.
- (7) Replace cover plate of slide block (3 screws M3).

4.9. ADJUSTMENT BRAKE C-ARM SLIDING

(see FZ-3)

If the moment of braking force is smaller than 45 Nm the brake can be adjusted as follows:

- (1) Put C-arm upside down for easily working position, and release brake handle C-arm sliding.
- (2) Remove coverplate of sliding block (2x M5 screw + 4x M4 screw).
- (3) Loosen the two fixing screws of brake unit.
- (4) Loosen the four set screws (socket screw M4) and push brake with rubber buffer against C-arm surface.
When sliding the C-arm, some friction of brake can be felt.
- (5) Turn the four set screws until the brake with rubber buffer is just lifted, and give one turn extra.
- (6) Tighten the two fixing screws, and check for a proper functioning of brake.
- (7) Replace coverplate of slide block.

4.10. ADJUSTMENT V-BELT MOTOR FOR VERTICAL MOVEMENT

(see FZ-3)

After replacement of motor or V-belts, the tension of V-belts must be adjusted.

To adjust the tension, proceed as follows:

- (1) Loosen a bit the 3 screws of the mounting base of motor (socket screws M6 + washers in elongated holes). Now the tension of V-belts can be adjusted by tightening the nut M6.
- (2) Tighten nut until mechanical stop.
- (3) Tighten the 3 fixing screws.
- (4) Close SE-door and replace front cover.

7.10. ADJUSTMENT PROCEDURE VHCU PMI100

BV25 can be delivered as a preferred system, with a Video Hard Copy Unit (VHCU) installed and tested by the factory.

NOTE

*FOR CALIBRATION AND PEDESTAL ADJUSTMENTS IN VHCU:
SEE MATRIX VHCU SERVICE MANUAL.*

Due to wide spread in film or chemicals fine adjustment is always necessary.

Following procedures are described:

- *Installation in BV25
- *50 Hz / 60 Hz video input changing
- *VHCU monitor alignment
- * Film calibration of positive and negative mode
- * Fine contrast and brightness adjustment (customer taste)

7.11. INSTALLATION

NOTE

*Before you install the VHCU in the system check the mains voltage and the video frequency.
If VHCU mains and video frequency is not corresponding with system data first carry out hardware adjustments before you build in the unit.*

7.11.1. Installation in a BV25 mobile system

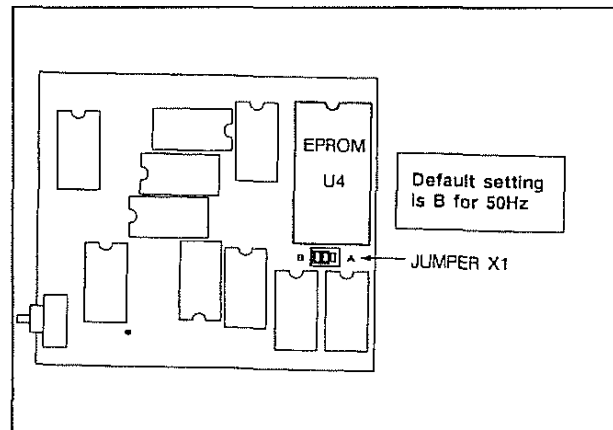
Remove front and rear cover of the BV25 trolley.
Mount VHCU on trolley base plate.

Connect premounted wiring in the BV25 trolley
Mains : premounted
Video : X5

Computer interface cable is not used for the PMI100

7.12. 50 Hz / 60 Hz VIDEO INPUT CHANGING

To change between 50 Hz and 60 Hz operation, remove cover and set jumper X1 as indicated in the figure.



NOTE

When changing the video frequency always carry out chapter VHCU MONITOR ALIGNMENTS !!, and chapter film calibration.

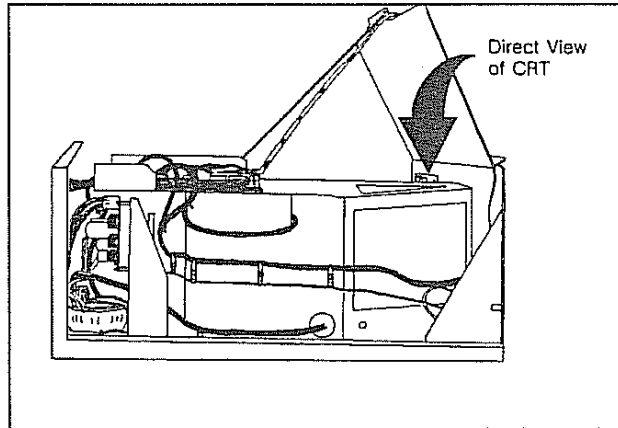
7.13. VHCU MONITOR ALIGNMENT

For matching the system video signal with the VHCU image geometry proceed as follows:

Be sure that jumper X1 is set in the correct position (50Hz/60Hz video input).

NOTE: VHCU is not build in, but placed near the BV system.

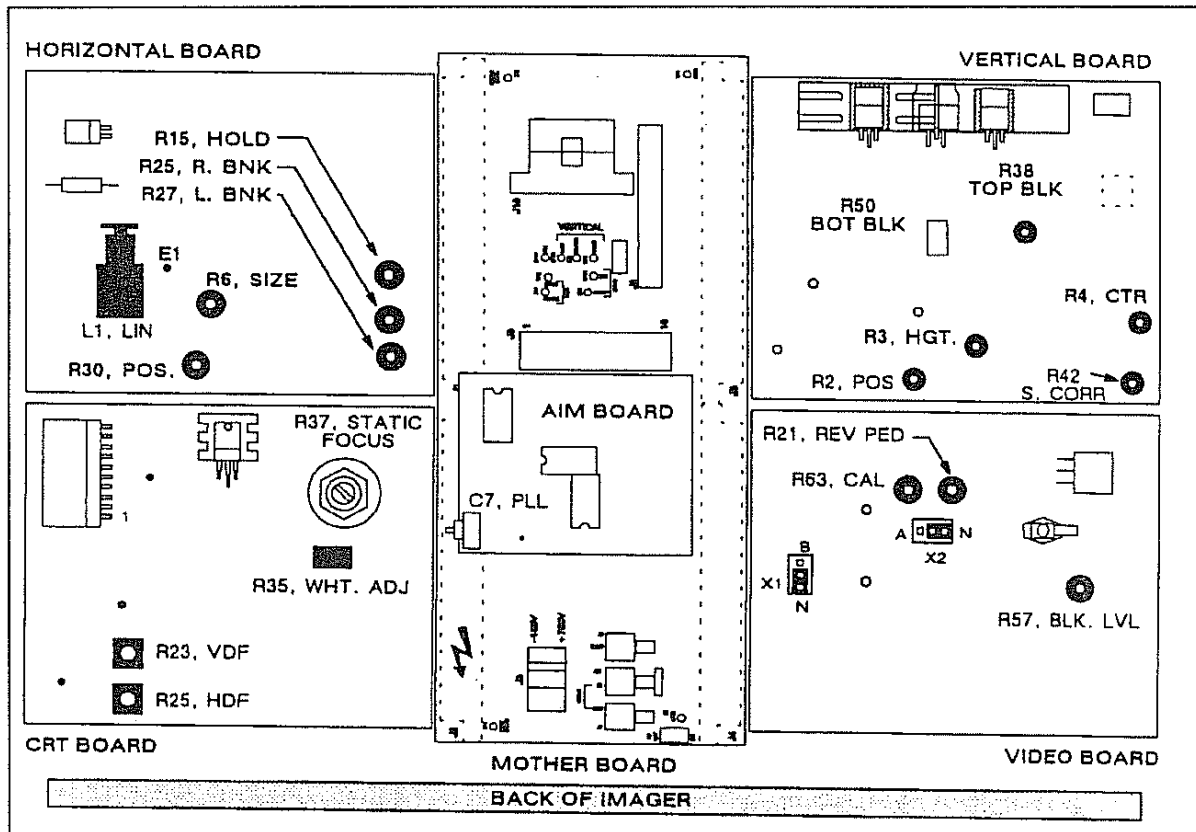
- * Remove top cover of the VHCU
- * Lift the monitor electronics plate



- * connect mains and video coax (see installation)
- * Switch on BV system and VHCU
- * Retrieve an image or carry out fluoroscopy.

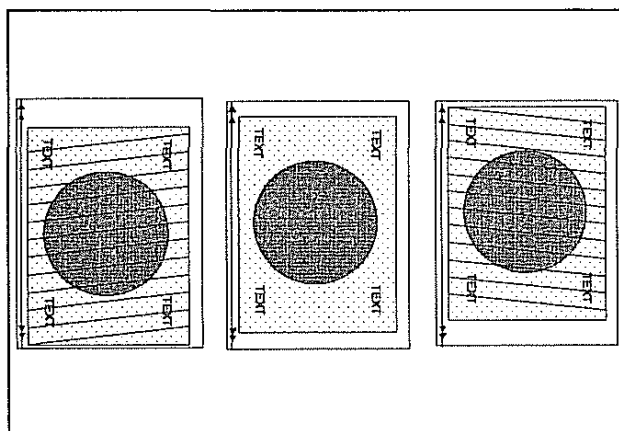
- * Wait for warming up (1min)
- * When IMG 1/* USR * *** appears push simultaneously RESET and PROG to enter service mode.
- * Use >> button to go to VW mode (=view mode, image permanent displayed on VHCU)
- * Turn up B =brightness and C =contrast to obtain a bright image on the VHCU monitor, use +/- buttons.
- * Place MASK phantom, delivered with this doc., on the screen of the VHCU monitor.

Use following potentiometers to adjust the image geometry.
See also VHCU documentation paragraph 3.3.7

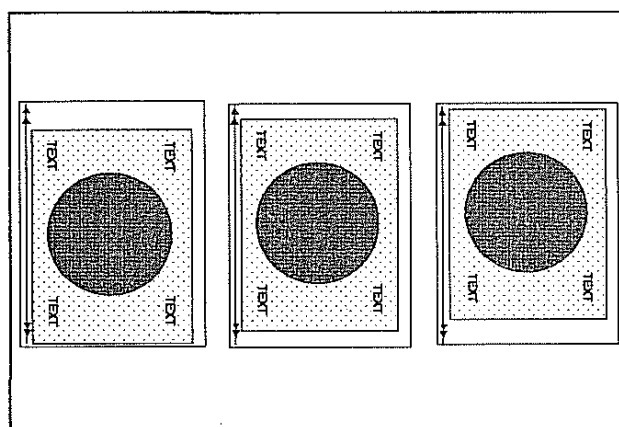


Horizontal adjustments

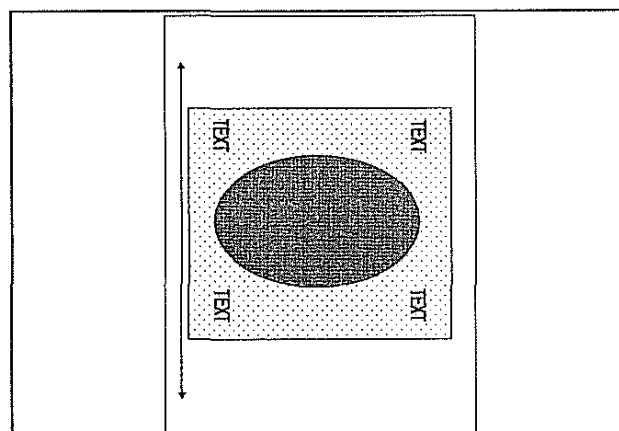
* Adjust **R15** to midpoint between lock-in limits.



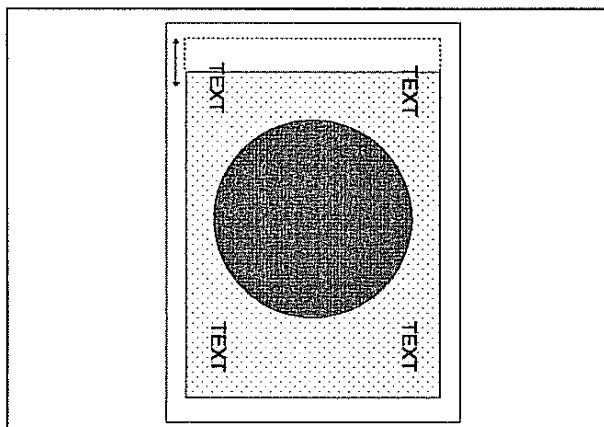
* Adjust **R30** for picture centring.



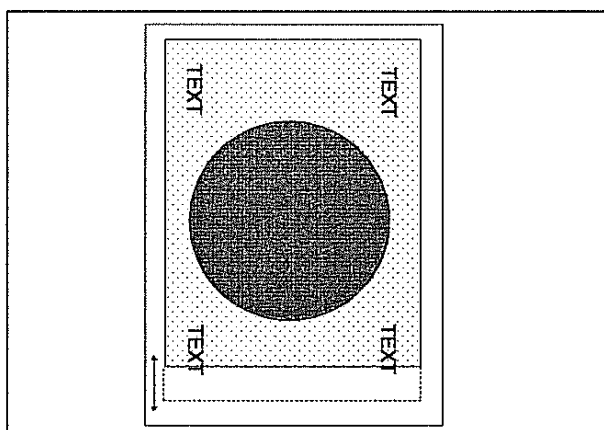
* Adjust **R6** for horizontal picture size.



- * Adjust **R25** for right blanking

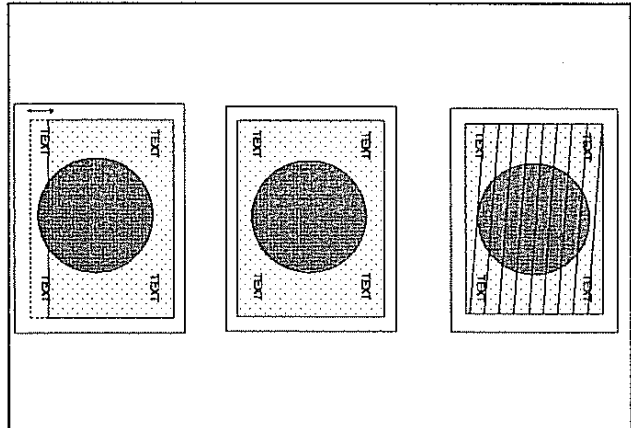


- * Adjust **R27** for left blanking

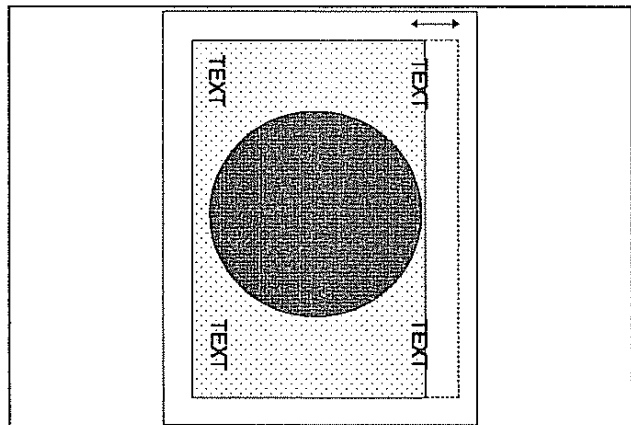


Vertical adjustments

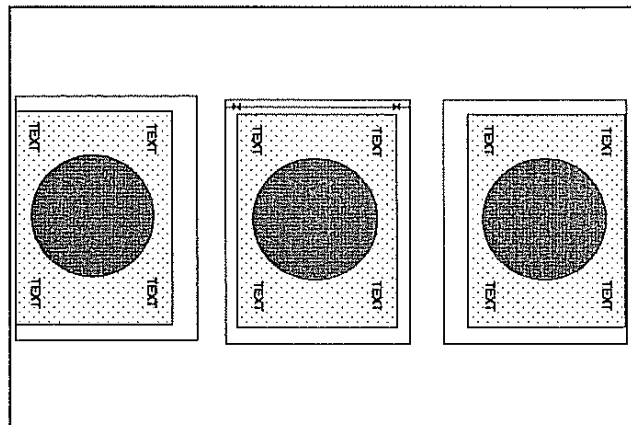
- * Adjust **R50** for bottom blanking



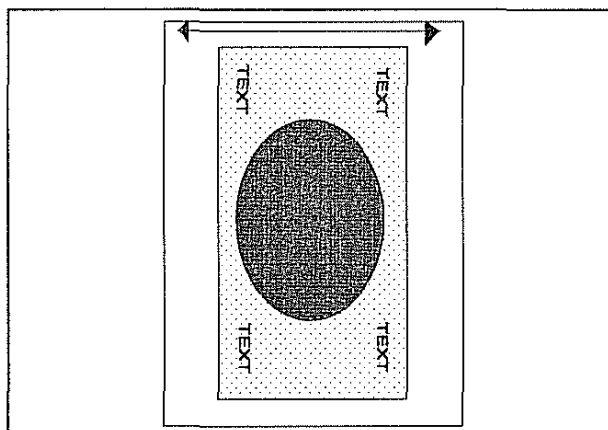
- * Adjust **R38** for top blanking



- * Adjust **R4** for picture centring



- * Adjust R3 for vertical picture size



7.14. FILM CALIBRATION OF POSITIVE AND NEGATIVE MODE FOR NORMAL FLUO IMAGES

Connect VHCU camera (VIDEO IN) to the mobile system (see paragraph installation).

Connect an oscilloscope to VHCU (VIDEO OUT). Use 75 Ohm terminator.

Fluo values has to be programmed under following menus:

Programm VHCU user mode IMG 1/x > USR 1 POS (= normal fluoro images)

IMG 1/x > USR 1 NEG (= normal fluoro images)

IMG 1/x > USR 3 POS (= normal fluoro images)

IMG 1/x > USR 3 NEG (= normal fluoro images)

FLUOROSCOPY					
50Hz Video, interlace = X2					
USER 1 POS. and USER 3 POS.			USER 1 NEG. and USER 3 NEG		
B: ***	C: ***	D: 056	B: ***	C: ***	D: 056
Video in: 350mV = 0.9 +/- 0.1 optical density 0mV = 1.8 +/- 0.1 optical density			Video in: 350mV = 0.9 +/- 0.1 optical density 0mV = 0.3 +/- 0.1 optical density		

FLUOROSCOPY					
60Hz Video, interlace = X2					
USER 1 POS. and USER 3 POS.			USER 1 NEG and USER 3 NEG		
B: ***	C: ***	D: 064	B: ***	C: ***	D: 064
Video in: 350mV = 0.9 +/- 0.1 optical density 0mV = 1.8 +/- 0.1 optical density			Video in: 350mV = 0.9 +/- 0.1 optical density 0mV = 0.3 +/- 0.1 optical density		

7.14.1. Calibrating positive mode

Carry out following step by step

- * Switch on the mobile system and VHCU

Apply a video signal from the system to the VHCU as the camera needs sync pulses.

- * On VHCU enter desired user and pos mode e.g. IMG 1/x > USR1 POS by using POS/NEG and 1/3 button.
- * Enter program mode by pressing PROG
- * Step with >> button to B*** >C*** D056 and fill in value 000 for (C)ontrast
- * Step with the >> button to B*** C000 >D056 and check if D=56 (50Hz) or D=64 (60Hz)
- * Step with the >> button to >B*** C000 D056 and fill in value of (B)rightness, use for estimating the values the reference film delivered with the VHCU.
- * Make exposures, develop film and measure if density is 0.9 +/- 0.1
- * If density is too high/low increase or decrease the (B)rightness value and make new exposures.
- * Correct brightness value for density 0.9 is now programmed for User 1 (=normal fluoro images) positive mode.

To find correct (C)ontrast value proceed as follows:

- 1 Obtain a 0mV video signal or measure outside the video circle.

- * Step with > button to > B and make sure the correct brightness with density 0.9 (found earlier) is programmed
- * Step with > button to B*** >C*** D056
- * Fill in value of (C)ontrast, use for estimating the values the reference film delivered with the VHCU.
- * Make exposures develop film and measure if density is 1.8 +/- 0.1 (outside the circle =0mV)
- * If density is too high/low increase or decrease the (C)ontrast value and make new exposures.
- * Correct contrast value for density is 1.8 is now programmed for User 1 (= **normal fluoro** images) positive mode.

The camera is now calibrated for user 1 positive mode (= **normal fluoroscopy** images).
Program same values of contrast and brightness under user 3 positive mode.

7.14.2. Calibrating negative mode

Carry out following step by step

- * Switch on the BV system and VHCU

Apply a video signal from the system to the VHCU as the camera needs sync pulses.

- * On VHCU enter desired user and neg mode e.g. IMG 1/x > USR1 NEG by using POS/NEG and 1/3 button.
- * Enter program mode by pressing PROG
- * Step with >> button to B*** >C*** D056 and fill in value 000 for (C)ontrast

- * Step with the >> button to B*** C000 >D056 and check if D=56 (50Hz) or D=64 (60Hz)
- * Step with the >> button to >B*** C000 D056 and fill in value of (B)rightness, use for estimating the values the reference film delivered with the VHCU.
- * Make exposures, develop film and measure if density is 0.9 +/- 0.1
- * If density is too high/low increase or decrease the (B)rightness value and make new exposures.
- * Correct brightness value for density is 0.8 is now programmed for User 1 (=normal fluoro images) negative mode.

To find correct (C)ontrast value, proceed as follows:

1 Obtain a 0mV !! video signal or measure outside the video circle.

- * Step with > button to B > and make sure the correct brightness with density 0.9 (found earlier) is programmed
- * Step with > button to B*** >C*** D056
- * Fill in value of (C)ontrast, use for estimating the values the reference film delivered with the VHCU.
- * Make exposures develop film and measure if density is 0.3 +/- 0.1 measure outside the video circle (0mV)!!
- * If density is too high/low increase or decrease the (C)ontrast value and make new exposures.
- * Correct contrast value for density is 0.3 is now programmed for User 1 (=normal fluor images) negative mode.

The camera is now calibrated for user 1 negative mode (= **Normal fluoroscopy images**).
 Programm same values of contrast and brightness under user 3 negative mode.

7.15. FILM CALIBRATION OF POSITIVE AND NEGATIVE MODE FOR SUBTRACTED IMAGES

Carry out film calibration of positive and negative mode for normal images. use following parameters:

SUB values has to be programmed under following menus:

Programm VHCU user mode IMG 1/X > USR 2 POS (= subtracted images)

IMG 1/X > USR 2 NEG (= subtracted images)

IMG 1/X > USR 4 POS (= subtracted images)

IMG 1/x > USR 4 NEG (= subtracted images)

SUBTRACTION					
50Hz Video, interlace = X2					
USER 2 POS. and USER 4 POS			USER 2 NEG and USER 4 NEG		
B: ***	C: ***	D: 056	B: ***	C: ***	D: 056
Video in: 350mV = 0.8 +/- 0.1 optical density 0mV = 2.0 +/- 0.1 optical density			Video in: 350mV = 0.8 +/- 0.1 optical density 0mV = 0.2 +/- 0.1 optical density		

SUBTRACTION					
60Hz Video, interlace = X2					
USER 2 POS. and USER 4 POS			USER 2 NEG and USER 4 NEG		
B: ***	C: ***	D: 064	B: ***	C: ***	D: 064
Video in: 350mV = 0.8 +/- 0.1 optical density 0mV = 2.0 +/- 0.1 optical density			Video in: 350mV = 0.8 +/- 0.1 optical density 0mV = 0.2 +/- 0.1 optical density		

7.16. FINE CONTRAST AND BRIGHTNESS ADJUSTMENTS

Only if necessary:

- * Retrieve a clinical image on the system
- * Chose user and mode on the VHCU
- * Press programm mode and toggle with the > button to change the (C)ontrast and (B)rightness values.
- * Press PROG to leave the programm mode.
- * Repeat session till desired image is achieved.

7.17. VHCU DENSITY GRAPH & MASK

For VHCU desity curves and special MASK transparency see FZ pages.

5. REPLACEMENT PROCEDURES

ATTENTION

Type plates and labels of PEI's Mobile stand (SA), Practix tank (GA), XTV8 TV chain (WK), diaphragm (LA), I.I. shield, I.I. tube (BB) and H.T. cascade generator (BG) are also located on the central information place, marked I, on the Mobile stand.

When replacing these PEI's, also the central information place must be updated with new type plates and labels.

5.1. REPLACEMENT PROCEDURE IMAGE INTENSIFIER

(see FZ-4 ,5)

- Should one of the H.T. sockets on the image intensifier break down (e.g. flash-over), replace not only the image intensifier but also the H.T. plug, screwed to the H.T. cables. Even if this plug does not seem to be damaged and does not break down, it can cause the coupling socket on the image intensifier to break down after having been in operation for some time.
- Demagnetize the screwdrivers because of the sensitivity to magnetic material of Csl input screen of the image intensifier.

NOTE

Only stainless steel screws have been used in I.I. input section.

- In view of implosion hazard of the image intensifier use a pair of safety glasses and protect your arms.
- Do not remove attachment plate BA for image intensifier shield from the C-arm in order not to influence the alignment with respect to the C-arm, the Practix C tank and the diaphragm unit.

Removal image intensifier (I.I.)

- (1) Switch off mobile stand. Set the C-arm upright with the I.I. up and lock.
- (2) Remove the camera cap and T.V. camera; see replacement procedure TV camera, section F-5.3
- (3) Loosen earth connections and locking flaps of the H.T. plugs. Disconnect the H.T. plugs X1, X2, X4 from the I.I. tube. Cover the H.T. plugs. Loosen mounting bracket from video cable.
- (4) Unscrew the spacers with spring washers (3x) from the flange around the I.I. output screen and keep them.
- (5) Fit the supplied plastic protective cap to the output screen of the I.I.
- (6) Unlock the C-arm and rotate it over 180°, the I.I. being down and lock again.
- (7) Remove the grid (4x counter sunk screw M4) from the I.I. shield.
- (8) Remove the metal ring from the I.I. shield 4x counter sunk screw M5).
- (9) Remove the black implosion plate 4x counter sunk screw M3).

- (10) Loosen the lock nuts (4x M4) at the input section one turn.
- (11) Loosen the adjusting screws (4x M4) alternately and uniformly up to stop.
- (12) Remove the rubber pressure tubes (4x) between the I.I. tube and shield.
- (13) Remove the input section out of the I.I. shield after unscrewing 8 counter sunk screws M4 at the outside edge of the I.I. shield.
- (14) Unlock the C-arm, set it in horizontal position and lock again.
- (15) Carefully slide the I.I. tube out of the shield and put it in the package.

Installation image intensifier (I.I.)

- (1) Set the C-arm in horizontal position and lock.
- (2) Unscrew the gauge pin from its parking position near the X2-mark on the I.I. shield and keep it.
- (3) Fit the type number plate of the new I.I. to the shield. Remove the old plate.
- (4) Do not yet remove the plastic protective cap from the output screen.
- (5) Slide carefully the I.I. tube into the shield and check that the I.I. tube properly seats on the joint face inside the shield.
- (6) Ensure that the reference pin in the shield fits into the appropriate hole in the I.I. tube.
- (7) Unlock the C-arm, set it upright with the I.I. down and lock again.
- (8) Put the input section so in the shield, that the red marks on the input section and on the edge of the I.I. shield coincide, and tighten the input section on the shield with 8 countersunk screws M4.
- (9) Position the rubber pressure tubes (4x) so between the I.I. screen and the input section, that the cut-outs of the input section are left free.
- (10) Use the adjusting screws to press alternately and uniformly the rubber tubes against the I.I. screen and use the gauge pin for this adjustment. The gauge pin should just fit between the I.I. screen and the aluminium ring.

Warning

Do not fit gauge pin too tight, implosion danger

- (11) Tighten the lock nuts, but keep the adjusting screws in its position with a screwdriver.
- (12) Fit the black implosion plate with 4 countersunk screws M3.
- (13) Fit the metal ring round the shield with 4 countersunk screws M5.
- (14) Fit the grid, if necessary, with 4 countersunk screws M4. The mark line should be perpendicular to the flat side of the I.I. shield.
- (15) Unlock the C-arm, set it upright with the I.I. up and lock again.
- (16) Reposition the gauge pin near the X2 mark.
- (17) Remove the caps from the H.T. sockets of the new I.I.
- (18) Grease, if necessary, the H.T. connections at the cable side and at the plug side.
- (19) Connect the H.T. plugs X1, X2, X4 and the grounding wires to the I.I. tube. Push the H.T. plugs firmly home.
- (20) Tighten the locking flaps of the H.T. plugs so that the plugs cannot be moved up and down. This is to prevent flash over of high tension.
- (21) Remove plastic protective cap from the I.I. output screen for coupling the camera.
- (22) Mount the 3 spacers and special spring washers supplied with the I.I.) on the metal ring round the output screen.

NOTE

*Before fitting the TV camera, the new I.I. can be checked for light output.
After system switch on, the I.I. output screen will light up at fluoroscopy command. Do not look directly into the output screen (X-ray beam).*

- (23) Fit the TV camera and the camera cap.
- (24) Check dose rate, see chapter "dose rate adjustment".
- (25) Update central information place "I" on Mobile stand with new type plates.

8.2. REPLACEMENT PROCEDURE H.T. CASCADE GENERATOR

- (1) Switch off mobile stand. Slide the C-arm to put I.I./tank in easily working position.
- (2) Remove camera cap and handgrip.
- (3) Loosen the locking flaps of H.T. plugs. Disconnect the H.T. plugs X1, X2, X4 from the I.I. tube.
- (4) Disconnect earth terminal from I.I. (2x nut M6) camera plug WK1: X4, BNC video plug from C-arm cable, plug BG: X1 from cascade generator and earth connection from cascade generator.
- (5) Support the I.I. container and carefully remove the 4 socket screws M6 from coupling plate BA.
- (6) Remove I.I. container and put it on a table weight is about 25 kg).
- (7) Unscrew the cascade generator from the coupling plate BA (4 screws M4).
- (8) Screw the new cascade generator at the coupling plate.
- (9) Attach earth connection from cascade generator and connect plug BG1:X1.
- (10) Mount I.I. container to base plate BA (4x screw M6).
- (11) Attach earth connection (2x nut M6), BNC video plug from C-arm cable and camera plug.
- (12) Check the H.T. plugs for enough grease and attach H.T. cable plugs BG1:X3 at the top, BG1:X4 at the centre and BG1:X5 at the bottom connection.
- (13) Tighten the locking flaps of the H.T. plugs.
- (14) Switch on the BV25 system and check the test voltages for the cathode voltage and the focusing voltage from the I.I. tube:
 - MP2-MP3: 5 V, giving a cathode voltage of -25 kV. Adjust cathode voltage with BG1:R1.
 - MP4-MP1: refer to Status Report Fluoroscopy BV25 delivered with the system. Adjust focusing voltage with BG1:R2.
- (15) During fluoroscopy, check the picture and focusing at the monitor screen.
- (16) Update the central information place "I" on mobile stand with new type plate and label.

8.3. REPLACEMENT PROCEDURE T.V. CAMERA

Refer to Service manual XTV8-S section F.

8.4. REPLACEMENT PROCEDURE PRACTIX-C TANK/DIAPHRAGM

- Do not remove the support bracket of the Practix-C tank and the diaphragm to keep its alignment with respect to the C-arm.
- Use package of new Practix-C tank and diaphragm unit for return shipment of defect unit.

Removal Practix C tank/diaphragm.

- (1) Switch off mobile stand. Set the C-arm upright with Practix C tank down and lock.
- (2) Remove the diaphragm cover (4 screws M3).
- (3) Detach the cable plug from connectors LAX1 and LAX2 of the diaphragm and the grounding wire.
- (4) Detach the tank cable plug from connector GAX1 (2 screws) of the tank. Not necessary for replacement of only the diaphragm.
- (5) Mark the position of the diaphragm unit on the support bracket for easy alignment.
- (6) Unscrew the 3 nuts with washers M4 and remove the diaphragm from the support bracket. Let it bear on a soft base to prevent damage to the diaphragm unit.
- (7) Remove the 3 socket screws M4 with brass washers and remove the shutter unit from the support bracket. Let it bear on a soft base to prevent damage to shutter unit.
- (8) Unscrew the 4 socket bolts M6 to remove the tank from the support bracket. Support tank-house at removal.

Installation Practix C tank/diaphragm

- (9) Attach the new tank to the support bracket by 4 socket bolts M6 x 16. If longer, the tank will be damaged inside. Support tank house.
- (10) Plug the tank cable in connector GAX1 of the tank.
- (11) Fit the shutter unit on the support bracket and screw it finger tight (3 screws M3 with brass washers)
- (12) Fit the diaphragm unit on the support bracket and screw it fingertight with 3 nuts M4 and the special washers.
- (13) Plug the diaphragm cable in the connectors LAX1 and LAX2 of the diaphragm unit and connect grounding wires.
- (14) Warm up the new X-ray tube, see X-ray tube warm up procedure, paragraph F-4.2.
- (15) Check the tube current for fluoroscopy and adjust the tube current for radiography, see adjustment procedure X-ray tube current, paragraph 4.1.
- (16) Align the diaphragm with respect to the Practix C tank, see adjustment procedure diaphragm, paragraph F-4.5
- (17) Attach the diaphragm cover with spacer (4 screws M3 and special washers).
- (18) Update the central information place "I" on Mobile stand with new type plate and label.

5.5. REPLACEMENT DIAPHRAGM UNIT - MOTORS - POTENTIOMETERS

At start of this procedure put the diaphragm unit in an easily working position:

- Put C-arm in upright position with diaphragm unit down and lock C-arm.
- Operate C-arm up button to move up C-arm.

Diaphragm unit

To replace the diaphragm unit on the support bracket attached to C-arm, proceed as follows:

Removal

- (1) Switch off the Mobile stand.
- (2) Remove diaphragm cover with spacer (4 screws M3).
- (3) Detach the cable plugs from diaphragm connectors LAX1 and LAX2.
- (4) Loosen earth wires from grounding terminal.
- (5) Remove 3 nuts M4 with brass washers from iris diaphragm unit. Lift iris diaphragm and let it bear on a soft base (e.g. foam) or let it bear only on its frame so that precision components are not damaged or deformed.
- (6) Remove 3 nuts M4 with brass washers from shutter unit. Lift shutter unit and let it bear on a soft base (e.g. foam) or let it bear only on its frame so that precision components are not damaged or deformed.

Installation

- (7) Take the new diaphragm out of its package and check it visually. Use package for return shipment of defect diaphragm.
- (8) Mount iris diaphragm unit and screw 3x nuts M4 with brass washers fingertight. Iris unit still has to be aligned.
- (9) Plug the diaphragm cable in connector LAX1 and attach the earth wires to grounding terminal.
- (10) Mount shutter unit and screw 3x nuts M4 with brass washers fingertight. Iris unit still has to be aligned.
- (11) Plug the shutter cable in connector LAX2.
- (12) Switch on the Mobile stand and operate in fluoroscopy mode (no X-rays) the iris buttons and shutter buttons to check the diaphragm unit for proper functioning.
- (13) Switch over to radiography mode (no X-rays) and check that the focus position motor slides the diaphragm carriage to the large focus position.(close to the C-arm)
- (14) Operate in radiography mode the format size buttons and check the iris diaphragm for proper functioning.
- (15) Check the diaphragm ready indication. (Error 3 on LCD display.) It is off when next conditions are all fulfilled:
 - after change of focus position
 - field size of iris < Ø 15 cm in fluoroscopic mode
 - after change of field size of iris in radiographic mode
- (16) Align the diaphragm unit with respect to the Practix C tank and image intensifier, see alignment procedure in section F-4.5.
- (17) Update the central information place "I" on Mobile stand with new type plate and label of beam collimation.

Diaphragm motor assemblies LAM1 - LAM4

To replace a motor in the diaphragm unit, proceed as follows: (See also FZ-7 and FZ-8)

- (18) Remove the diaphragm unit as described above under heading diaphragm unit.
- (19) Handle the diaphragm unit carefully and let it bear so on its frame that precision components (some protruding) cannot be damaged or deformed.

Iris field size motor LAM1

- (20) Remove spring from springholder attached to motor support.
- (21) Remove screw from elongated hole at motor support (socket screw M3).
- (22) Remove 2x screw M3 from motor support attached at iris diaphragm carriage (bottom side of carriage).
- (23) Unsolder connecting wires of iris position motor. Mind the polarity of wires.
- (24) Remove motor with motor support from iris diaphragm carriage.
- (25) Remove the gearwheel of motor shaft (socket screw M2).
- (26) Remove motor from motor support (2 x screw M2).
- (27) Attach new motor to motor support.
- (28) Attach gear wheel to motor shaft.
- (29) Attach motor with motor support to iris diaphragm carriage and set screws finger tight (2x screws motor support, 1x screw in elongated hole).
- (30) Shift gear wheels of motor and iris diaphragm for minimum play.
- (31) Tighten screws of motor support.
- (32) Tighten screw in elongated hole.
- (33) Position spring in spring holder attached to motor support.
- (34) Solder motor connection wires to motor.

Shutter field size motor LAM2

- (35) Unscrew mounting base with motor and potentiometer attached from shutter carriage (3x screw M1.5).
- (36) Remove motor with motor support attached from mounting base.
- (37) Unsolder connection wires of motor. Mind the polarity of wires.
- (38) Remove gear wheel of motor shaft (socket screw M2)
- (39) Unscrew motor from motor support (2x screw M2).
- (40) Attach new motor to motor support.
- (41) Attach gear wheel to motor shaft.
- (42) Solder connection wires to motor.

For adjustment of geared belt proceed as follows:

- (43) Attach motor with motor support to mounting base, and set screws finger tight.
- (44) Put geared belt over gear wheels of motor and potentiometer LAR2 and position carrier in guide bracket.
- (45) Tension geared belt and tighten screws in motor support (elongated holes).
- (46) Check that the centres of gear wheels are aligned and that the geared belt is tensioned.
- (47) Attach mounting base to shutter support (3x screw M2). Check that the pin of carrier is put in guide bush of shutter unit.
- (48) Perform adjustment procedure of diaphragm potentiometers, section F4.6

Shutter rotation motor LAM3

- (49) Unsolder connection wires of motor. Mind the polarity of wires.
- (50) Remove gear wheel of motor shaft (socket screw M2)
- (51) Remove motor from motor support (2x screw M2).
- (52) Attach new motor to motor support (2x screw M2).
- (53) Attach gear wheel to motor shaft.
- (54) Loosen screws in elongated holes of motor support (2x) and adjust gear wheels of motor shaft and shutters for minimum play.
- (55) Tighten screws of motor support
- (56) Solder connecting wires to motor.

Focus position motor LAM4

- (57) Unsolder the connection wires of motor. Mind the polarity of wires.
- (58) Remove gear wheel of motor shaft (socket screw M2)
- (59) Remove motor from iris diaphragm carriage.
- (60) Attach new motor to iris diaphragm carriage.
- (61) Attach gear wheel to motor shaft.
- (62) Solder connecting wires to motor, mind the polarity.

Diaphragm potentiometer assemblies LAR1-LAR4

To replace a potentiometer in the diaphragm unit, proceed as follows: (see also FZ-7 and FZ-8).

- (63) Remove the diaphragm unit as described above under heading diaphragm unit.
- (64) Handle the diaphragm unit carefully and let it bear so on its frame that precision components (some protruding) cannot be deformed or damaged.

Iris field size potentiometer LAR1

- (65) Unsolder connecting wires of potentiometer LAR1: LAR1:1 (1x), LAR1:2 (1x), LAR1:3 (2x).
- (66) Remove screws for clamp plates of potentiometer (2x screw M3) and remove potentiometer with gear wheel attached.
- (67) Remove gear wheel of potentiometer shaft.
- (68) Attach new potentiometer with gear wheel attached to iris diaphragm carriage.
- (69) Adjust the gear wheels of iris diaphragm and potentiometer for minimum play and set clamp plates of potentiometer finger tight.
- (70) Solder connection wires to potentiometer.
- (71) Perform diaphragm adjustment procedure, see section F-4.6

Shutter field size potentiometer LAR2

- (72) Unscrew mounting base with motor and potentiometer attached from shutter carriage (3x screw M1.5).
- (73) Unscrew potentiometer with potentiometer support attached from mounting base (2x screw M2 at rear side of mounting base).
- (74) Unsolder connecting wires of potentiometer LAR2: LAR2:1 (1x), LAR2:2 (1x), LAR2:3 (2x).
- (75) Remove gear wheel of potentiometer shaft (socket screw M2).
- (76) Remove screws for clamping plates of potentiometer LAR2.
- (77) Remove potentiometer from potentiometer support.
- (78) Attach new potentiometer to potentiometer support and set screws for clamping plates finger tight.
- (79) Attach gear wheel to potentiometer shaft.
- (80) Solder connecting wires to potentiometer.
- (81) Attach potentiometer with potentiometer support to shutter carriage (2x screw M2).

For adjustment of geared belt proceed as follows:

- (82) Loosen screws of motor support (screws M2 in elongated holes).
- (83) put geared belt over gear wheels of motor and potentiometer and position carrier in guide bracket.
- (84) Tension geared belt and tighten screws in motor support (elongated holes).
- (85) Check that the centres of gear wheels are aligned and that the geared belt is tensioned.
- (86) Attach mounting base with motor and potentiometer to shutter carriage (3x screw M1.5).
- (87) Perform diaphragm adjustment procedure, section F4.6.

Shutter rotation potentiometer LAR3

- (88) Unsolder connecting wires of potentiometer LAR3: LAR3:1 (2x), LAR3:2 (1x), LAR3:3 (2x).
- (89) Loosen gear wheel of potentiometer shaft (socket screw M2).
- (90) Remove screws of clamping plates of potentiometer.
- (91) Remove potentiometer from shutter carriage.
- (92) Attach new potentiometer to shutter carriage and set screws of clamping plates finger tight.
- (93) Tighten screw of gear wheel.
- (94) Solder potentiometer wires to potentiometer LAR3.
- (95) Perform adjustment procedure of shutter rotation potentiometer, section F4.6

Focus position potentiometer LAR4

- (96) Remove mounting bracket of connector LAX1 from iris diaphragm carriage (2x socket screw M4).
- (97) Unsolder connecting wires of potentiometer LAR4: LAR4:1 (2x), LAR4:2 (1x) and LAR4:3 (2x).
- (98) Loosen gear wheel of potentiometer shaft (socket screw M2).
- (99) Remove screws for clamp plates of potentiometer (2x screw M3) and remove potentiometer.
- (100) Attach new potentiometer to iris diaphragm carriage and set screws for clamping plates finger tight.
- (101) Attach gear wheel to potentiometer shaft, and adjust gear wheels of focus position and potentiometer for minimum play.
- (102) Solder connecting wires to potentiometer.
- (103) Perform adjustment procedure diaphragm potentiometers, see section F-4.6.
- (104) Attach bracket of connector LAX1 (2x socket screw M4).

5.6. REPLACEMENT PROCEDURE C-ARM BALL BEARINGS

The slide block has two kinds of ball bearings:

4 x 4 running and 2 x 2 side ball bearings.

At the inner side of C-arm there are 4 x 2 running bearings (upper part) and 2 x 2 side bearings; at the outside there are 4 x 2 running bearings (lower part).

The ball bearings at outside are adjustable, by eccentric.

NOTE

After a long standstill position of C-arm the sliding movement can be irregular (a bit jerky) by flattened nylon ball bearings, caused by the weight of C-arm. After some sliding movements the flattened nylon ball bearings are round again and the sliding movement runs smooth.

To replace the nylon ball bearings, the C-arm must run off the slide block; proceed as follows:

- (1) Put C-arm manually in horizontal position and lock
- (2) Move C-arm up/down to let it bear on a table.
- (3) Switch off Mobile stand.
- (4) Remove TV camera cap (3 screws).
- (5) Detach cables:
 - H.T. cable plugs at I.I.
 - Camera control cable plug
 - Grounding wires
 - C-arm cable plug
- (6) Remove I.I. shield containing I.I. tube and TV camera by unscrewing 4 socket screws on coupling plate BA.
- (7) Loosen upper part of brass clamping block.
- (8) Unscrew lower part of brass clamping block (2 socket screws) and coupling plate BA 2 socket screws) from end block in C-arm. Remove earthing connections (3 thin cables, 1 thick cable).
- (9) Slide coupling plate BA over cables.
- (10) Unscrew end block from C-arm (2 black socket screws and 2 nuts).
- (11) Ride C-arm horizontally off slide block. Weight of C-arm is about 40 kg.
- (12) Remove lower cover plate of slide block and suspension bracket for C-arm cable hose 4x screw M3 + 2x screw M5).
- (13) Decouple brake handle from eccentric at eccentric.
- (14) Remove bearing block out of slide block 4x socket screws).
- (15) Check surface and running of ball bearings running and side) to find out which bearings should be replaced.
- (16) In case of running ball bearings detach retaining ring(s) and pull off the ball bearings(s). In case of side ball bearings push pin out of ball bearing or screw eccentric pin out of ball bearing.
- (17) Fit new running and/or side ball bearings with retaining ring resp. pin.

NOTE

Do not touch screw settings at bearing block to avoid more mechanical adjustment.

- (18) Fit bearing block again in slide block with 4 socket screws and washers.
- (19) Ride C-arm horizontally on slide block to check that ball bearings touch the C-arm edge for smooth sliding; especially the side ball bearings. The side ball bearing touching can be adjusted by screw pins; the running ball bearing touching can be adjusted by screws (see also adjustment procedure). After adjustment, screw pin must be fixed with screw.
- (20) When C-arm runs smoothly in bearing block, all parts detached to reach the ball bearings can be attached again: stop block at end of C-arm, coupling plate BA, brass clamping block to ground shield of cables, I.I. shield with I.I. tube and TV camera, cable plugs and grounding wires, camera cap; couple brake handle to eccentric, and attach cover plate at slide block and suspension bracket for C-arm cable hose.

5.7. REPLACEMENT PROCEDURE DISC C-ARM ROTATION

To replace brake disc for the rotational movement of C-arm, proceed as follows:

- (1) Remove upper cover plate of slide block (3x screw M3).
- (2) Remove stop bracket completely (2x socket screw M4).
- (3) Remove both brake handles.
- (4) Remove brake handle shaft, and watch bearings and washers.
- (5) Remove block with guide pin for pressure piece (2x screw M4).
- (6) Remove pressure piece.
- (7) Remove metal strip from zigzag sheet attached to bearing block for horizontal movement (2x screw M3).
- (8) Unscrew lock nut M8 behind zigzag sheet, and loosen special bolt M8 by hammering on nut side.
- (9) Turn two screws M4 in holes from brake disc as a help to remove the disc, and pull off disc.
- (10) After replacement of new brake disc, mount a new lock nut M8 on bolt M8.
- (11) Replace pressure piece and block with guide pin (2x screw M4).
- (12) Replace handle shaft with bearings and washers.
- (13) Replace both brake handles and stop bracket.
- (14) Adjust braking force of rotational movement:
 - release brake handle
 - loosen two fixing screws in brake plate (2 socket screws M4)
 - Turn brake plate counter clockwise against eccentric to adjust braking force
 - tighten the two fixing screws. Select best position of 6 holes.
- (15) Adjust horizontal position of brake handle by set screw on stop bracket.
- (16) Replace cover plate of slide block.
- (17) Mount metal strip from zigzag sheets 2x screw M3).

5.8. REPLACEMENT BRAKE C-ARM SLIDING

(see FZ-1)

To replace the rubber buffer in bush for brake of sliding C-arm movement, proceed as follows:

- (1) Remove suspension bracket for C-arm cable hose 2x screw M5).
- (2) Remove lid at lower side of slide block.
- (3) Decouple handle-eccentric bar at eccentric.
- (4) Remove fixing screws of brake assembly (2x socket screw M4).
- (5) Take assembly with rubber buffer and eccentric out of slide block.
- (6) Detach eccentric by removing retaining ring. Attention for spring pressure pushing up rubber buffer.
- (7) Remove retaining ring and washer at buffer bush.
- (8) Remove buffer bush and put new one in.
- (9) Attach washer and retaining ring at buffer bush.
- (10) Push buffer bush in housing against spring pressure.
- (11) Fit eccentric in position and place retaining ring.
- (12) Fit assembly with rubber buffer and eccentric in slide block.
- (13) Tighten assembly with 2 socket screws.
- (14) Couple handle-eccentric bar again at eccentric.
- (15) Adjust braking force of sliding C-arm movement, see adjustment section F-4.9.
- (16) Replace lid and suspension bracket of C-arm cable hose.

8.9. REPLACEMENT PROCEDURE SYSTEM POWER SUPPLY

To replace the power supply unit SU, proceed as follows:

- (1) Remove front cover and side covers from stand.
- (2) Open SE door.
- (3) Disconnect wires from terminals L, N, and 1-14
- (4) Remove plexiglass coverplate from SM unit (4x M4) to reach fixing screws of SU.
- (5) Unscrew SU unit from mounting plate (4x socket screw M4 at rear side of SU).
- (6) Mount new SU unit to plate.
- (7) Mount cover plate to SM unit (4x screw M4).
- (8) Attach wires to terminals of SU unit.
- (9) Disconnect plug SE10:X8 from SU:X1.
- (10) Check output settings from SU unit, see section A.
- (11) Connect plug SE10:X8 to SU:X1.
- (12) Check if system switches on correctly:
 - power-on lamp is on
 - automatic fluoroscopy lamp is on
 - fluoroscopy kV-mA display shows 40 kV - 0.1 mA
 - *fluoroscopy time display shows 00.0 minutes*

If all power supplies are present, error 5 is not indicated, when the "hidden button DPERCM" (next to "ON" button), is pressed.

- (13) Close SE door and fit covers to stand.

5.10. REPLACEMENT PROCEDURE VERTICAL MOVEMENT MOTOR

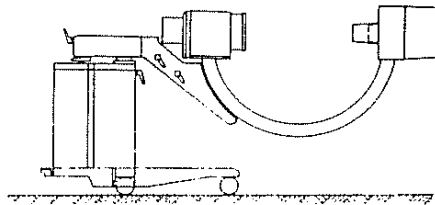
(see FZ-6)

To replace the motor for vertical movement, the stand must first be tilted sideways. (Weight of stand about 240 kg).

Next, the four V-belts must be removed, and then the motor can be replaced.

To tilt the stand, proceed as follows:

- (1) Slide C-arm to put tank-II in horizontal position, and lock brake handle.



- (2) Rotate C-arm to put C-arm upside down, until safety lock is activated (about 155°). Lock brake handle.
- (3) Put C-arm in maximum scanning direction about 12°. Lock brake handle.
- (4) Put a chair or small table under suspension bracket of footswitch to support the stand when it is tilted.
- (5) Lift the stand to tilt it sideways. To reach a stable position of stand and C-arm, let the tank and II rest on the floor, and let the stand compartment rest on the chair.
- (6) Remove back cover from stand.
- (7) Carefully open SE door, and support it with e.g. a chair to protect the hinges.
- (8) Remove bottom plate from stand (12x screw M4). The motor for vertical movement is mounted on a base plate. On this base plate an adjustable spring is mounted for the tension of V-belts.
- (9) Remove nut M6 for spring adjustment.
- (10) Remove the three screws of mounting base (socket screws M6 with elongated holes).
- (11) Lift motor, put off the V-belts and remove motor from stand.
- (12) Remove motor from mounting base (4x screw M6), remove pulley and replace motor by a new one. Mount pulley again.
- (13) Remove pulley from spindle for vertical movement 3x socket screw M4).

NOTE

The pulley can be kept in position by putting a screwdriver through holes in pulley and baseframe.

- (14) Check the V-belts for excessive wear.
- (15) Put the four V-belts on the spindle pulley and fix them to the pulley with adhesive tape.
- (16) Mount pulley with V-belts to spindle and tighten the 3 fixing screws. Take care that the V-belts do not come loose.
- (17) Mount the motor/base in the stand and put the V- belts on the motor pulley. Turn the fixing screws in elongated holes finger tight and adjust the spring for some V-belt tension.

Caution

Motor pulley and spindle pulley must be aligned to 0 ± 0.05 mm to prevent excessive wear of V-belts. The position of the motor pulley can be adjusted on the motor shaft. Use a ruler as alignment tool.

- (18) Adjust V-belt tension, see adjustment procedure section F-4.10.
- (19) Replace bottom plate (12x screw M4).
- (20) Put the stand back to the floor.
- (21) Switch on stand and check C-arm up/down movements, and listen to V-belts for smooth operation.

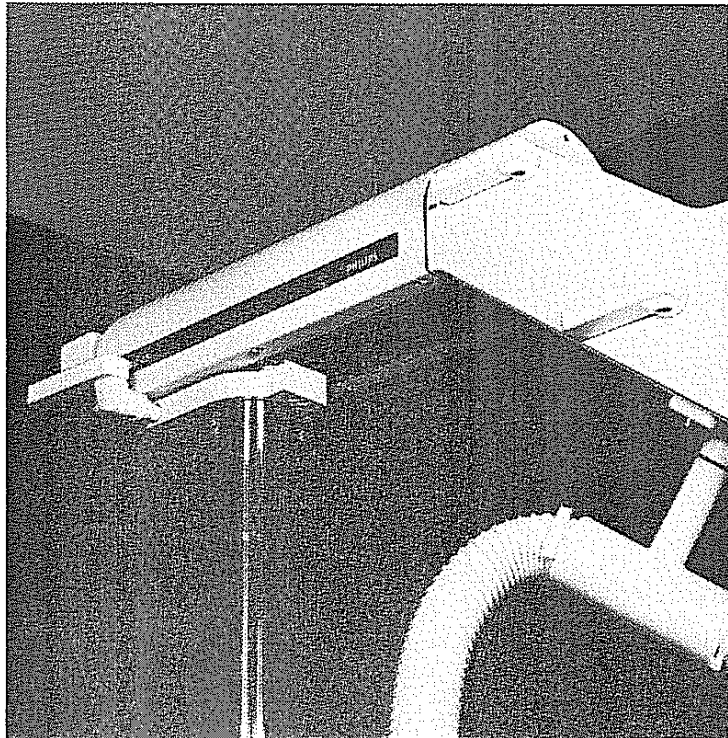
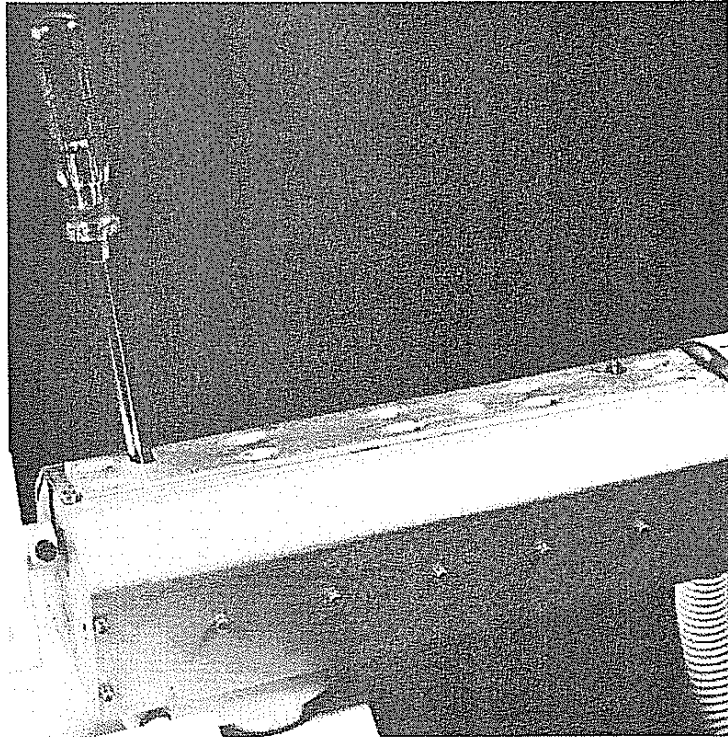
5.11. DECOUPLING C-ARM FROM STAND

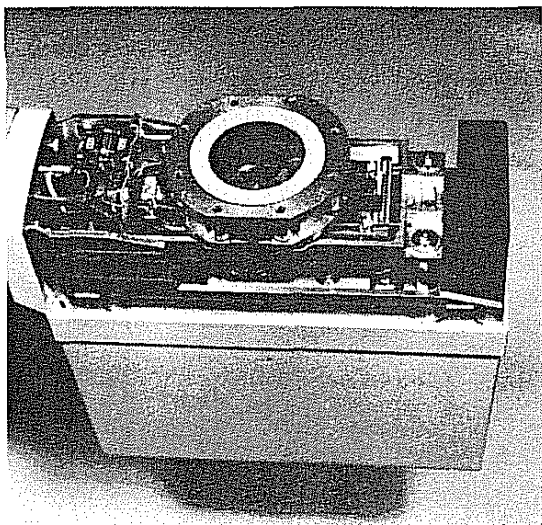
Decoupling the C-arm from the vertical tube of the mobile stand is done by sliding off the horizontal support of the C-arm from the ball bearings block mounted on top of the vertical tube.

Proceed as follows:

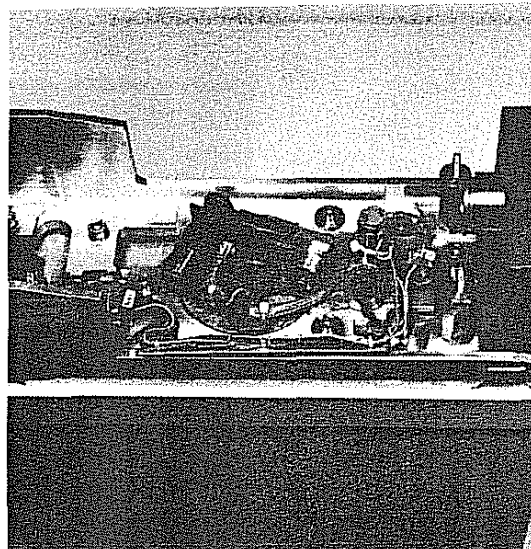
- (1) Remove cover of horizontal support of C-arm (6x screw/special washer). See FZ-1.
- (2) Remove brake handle.
- (3) Loosen zigzag sheets at both side of vertical tube; see FZ-1.
- (4) Rotate C-arm horizontally with C-arm cable input up and position a table such that C-arm at moving downwards can rest on this table.
- (5) Unscrew plate (7x socket screw) at handle side.
- (6) Remove plate with zigzag sheet and brake shaft attached.
- (7) Put a supporting piece of wood under stand base at brake pedal side (to prevent toppling over)
- (8) Slide C-arm horizontally off from ball-bearing block on vertical tube.
- (9) Four ball-bearings at each side can be checked now and replaced if necessary.
- (10) Two side ball-bearings at each side can be checked now and replaced if necessary.
- (11) Side ball-bearings at one side can be adjusted by eccentric screws for a smooth running of horizontal movement of C-arm. (See FZ-1) These eccentric screws can be reached and set through holes in the housing of the horizontal support of the C-arm.

6. ILLUSTRATIONS

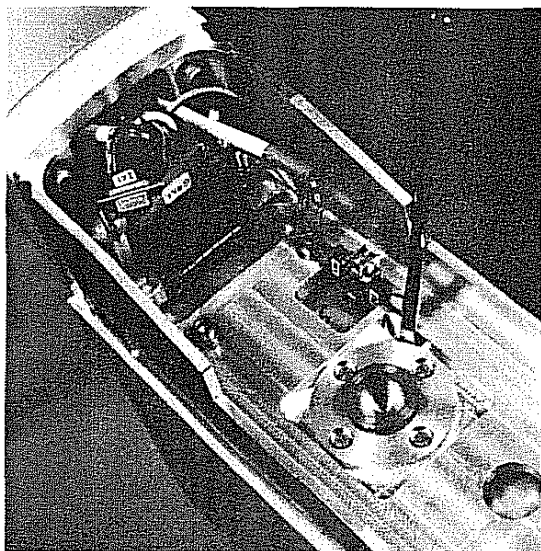




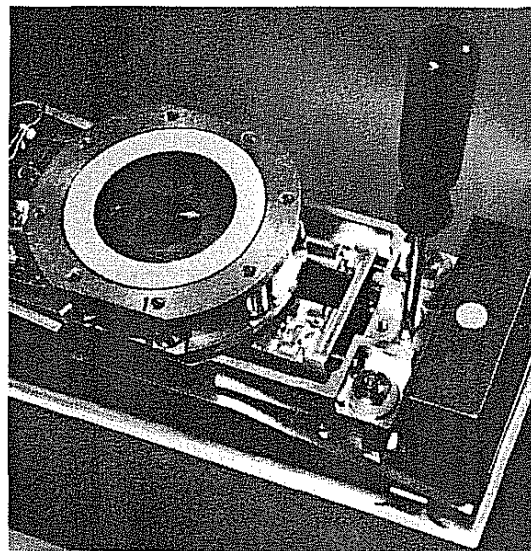
1) Diaphragm unit consisting of iris diaphragm, semi-transparent shutters and focus-near ring.



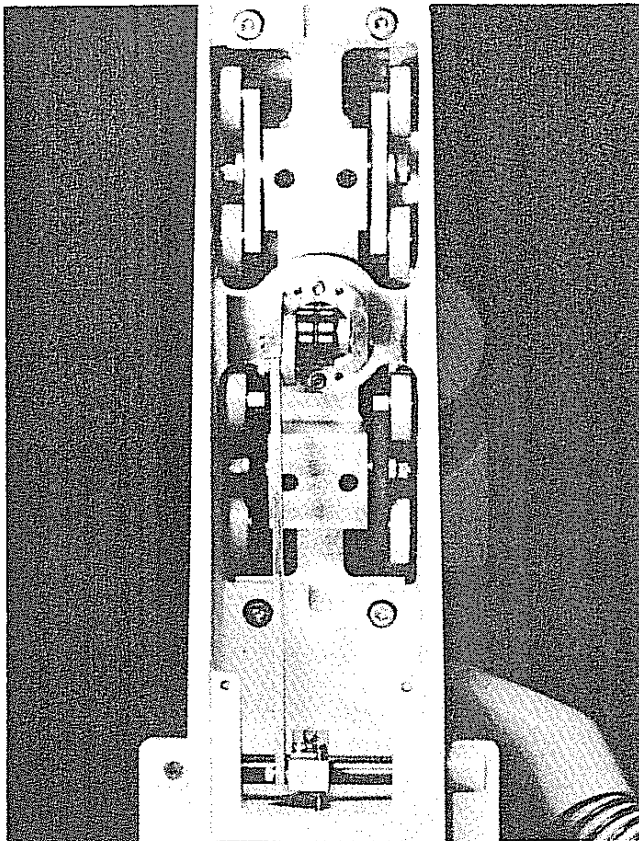
3) Alignment of shutter unit with respect to Practix-C tank.



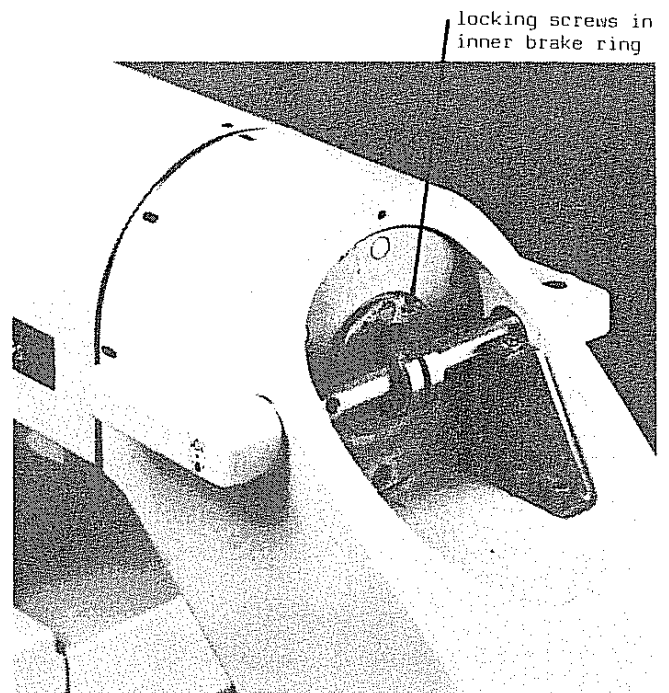
2) Iris diaphragm and shutter unit removed.
Alignment of focus-near ring with respect to Practix-C tank.
The brass pot is placed in ring as alignment tool.



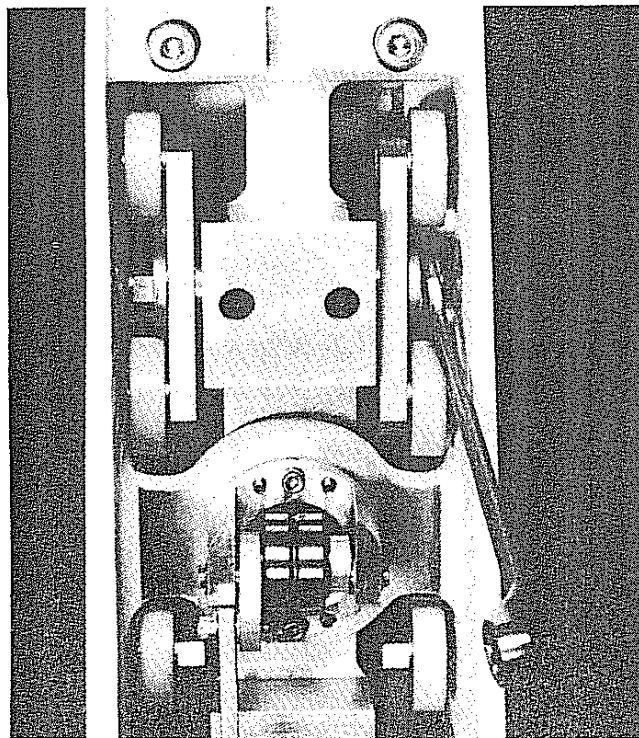
4) Alignment of iris diaphragm unit with respect to Practix-C tank. The screwdriver can be used as "joystick" to shift iris diaphragm.



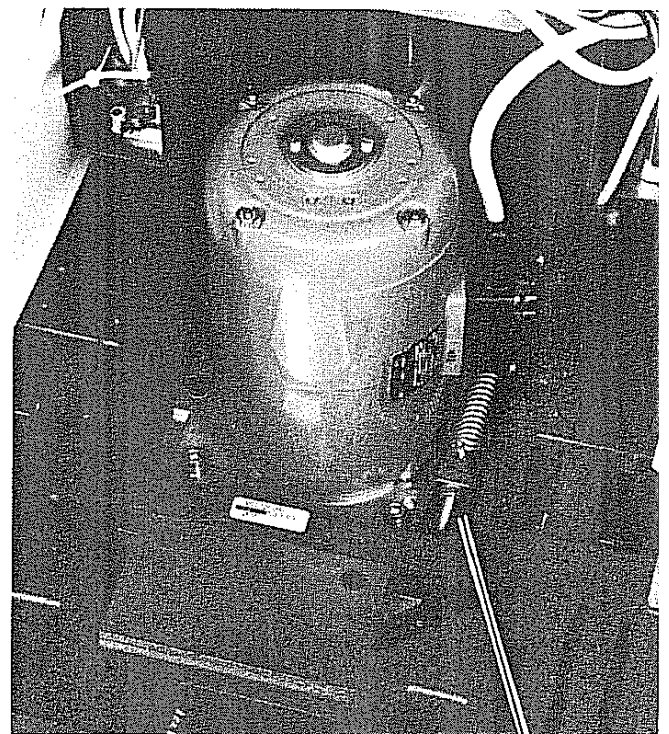
1) Brake and ball bearings in slide block (lower part).



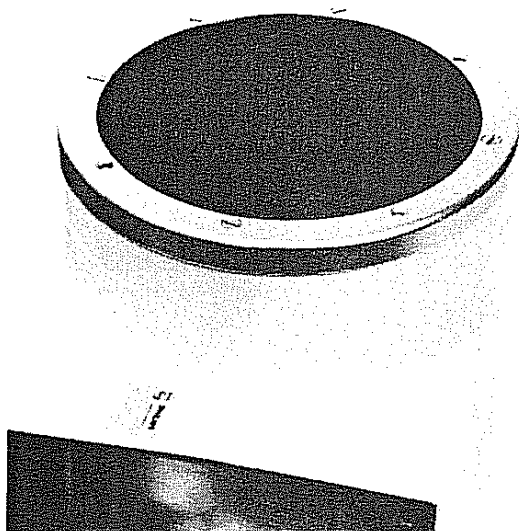
3) Adjustment of brake C-arm rotation.



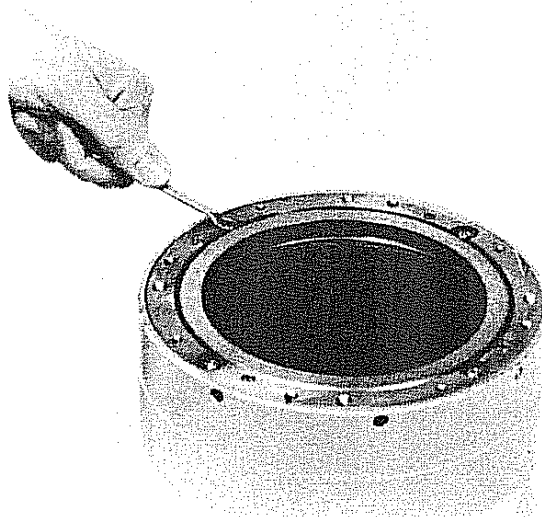
2) Adjustment of ball bearings in slide block.



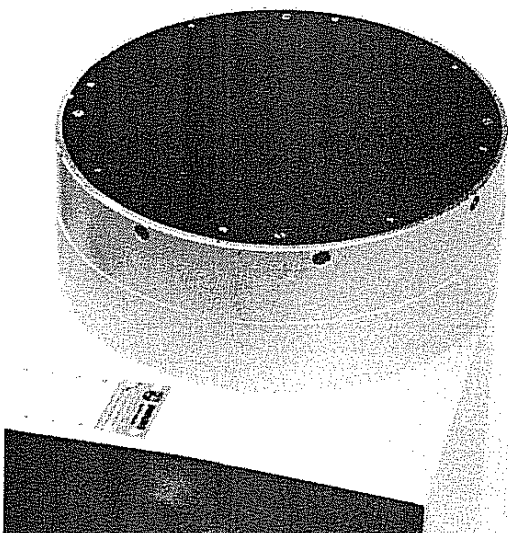
4) Adjustment V-belts of motor for vertical movement.



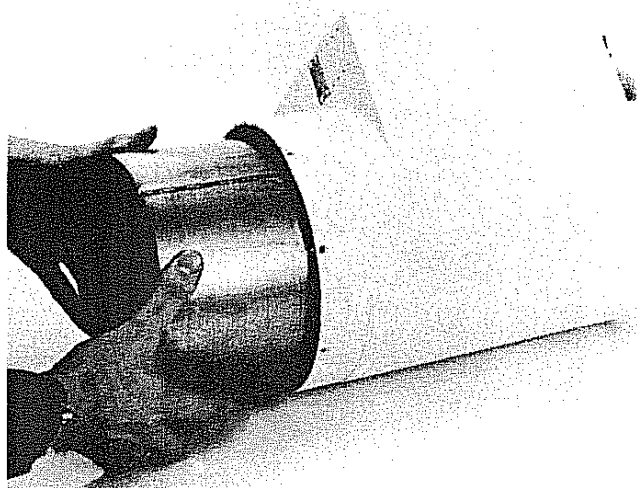
1) I.I. shield with metal ring installed.



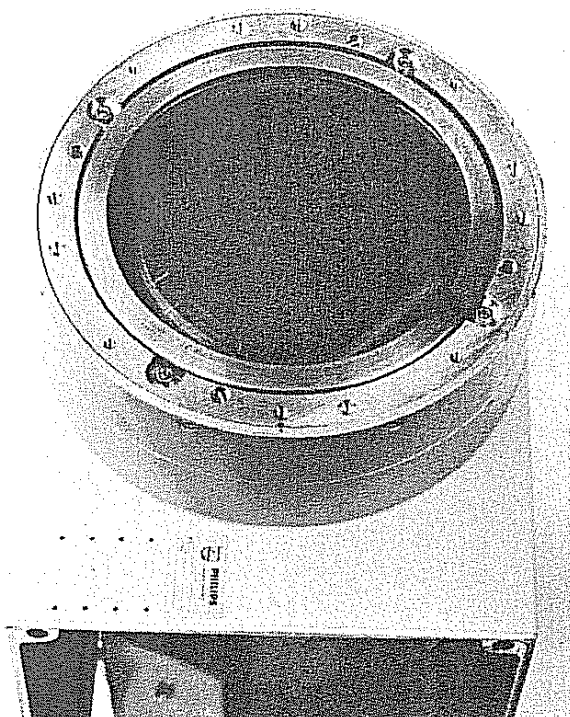
3) I.I. shield with input section installed and illustration of loosening the lock nuts.



2) I.I. shield with implosion plate installed.



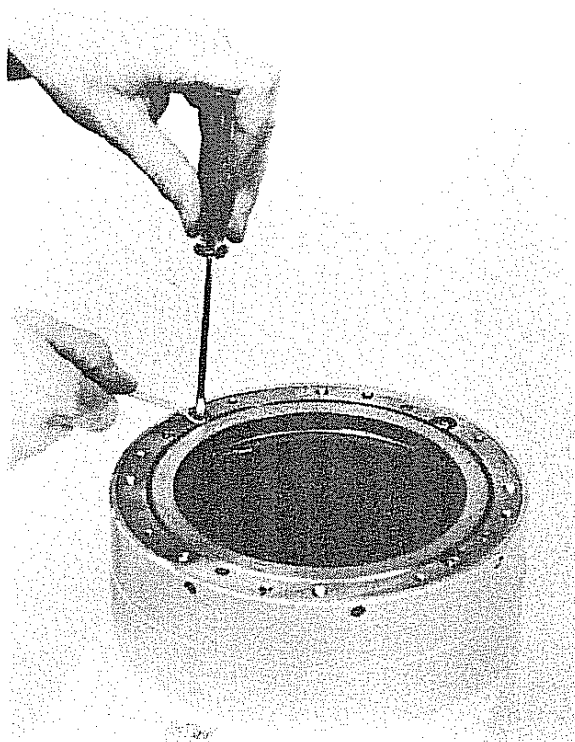
4) Illustration of sliding the I.I. tube out of or into the I.I. shield.



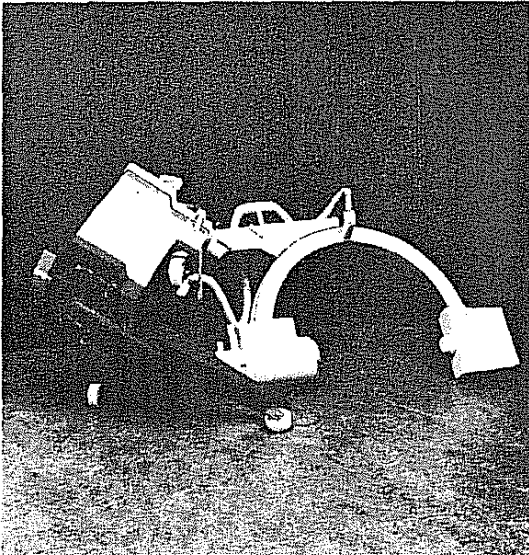
1) Illustration of positioning the input section in the I.I. shield (red marks) and the rubber pressing tubes between the I.I. screen and the input section leaving the cut-outs free.



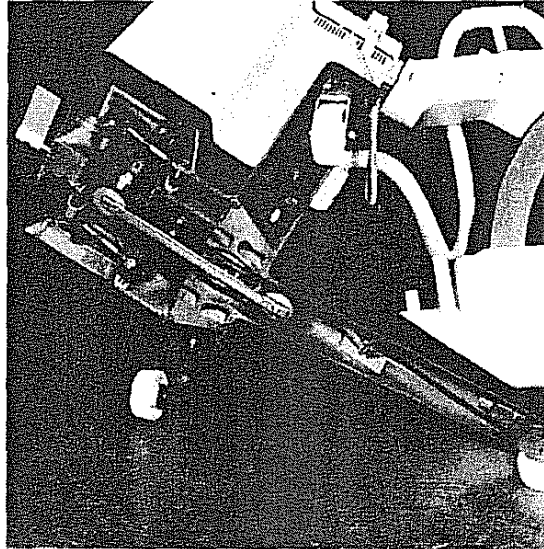
3) Illustration of tightening the lock nuts and holding the adjusting screws in its position.



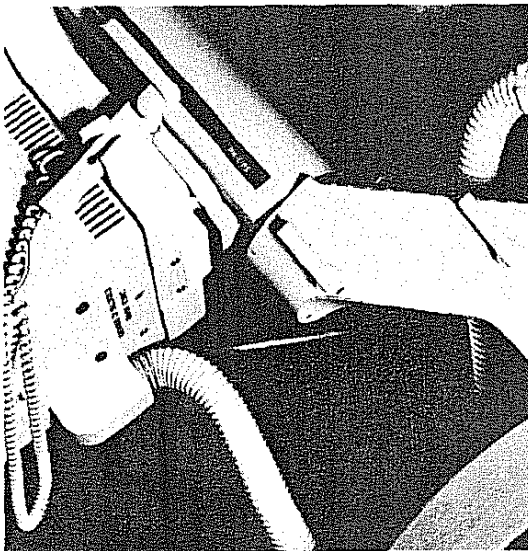
2) Illustration of pressing the rubber tubes against the I.I. screen by using the adjusting screws and the gauge pin.



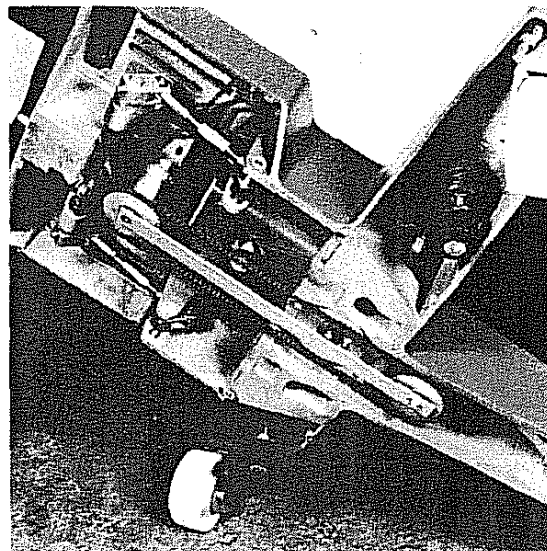
1) Illustration of tilting the stand for replacement of motor or V-belts for vertical movement.



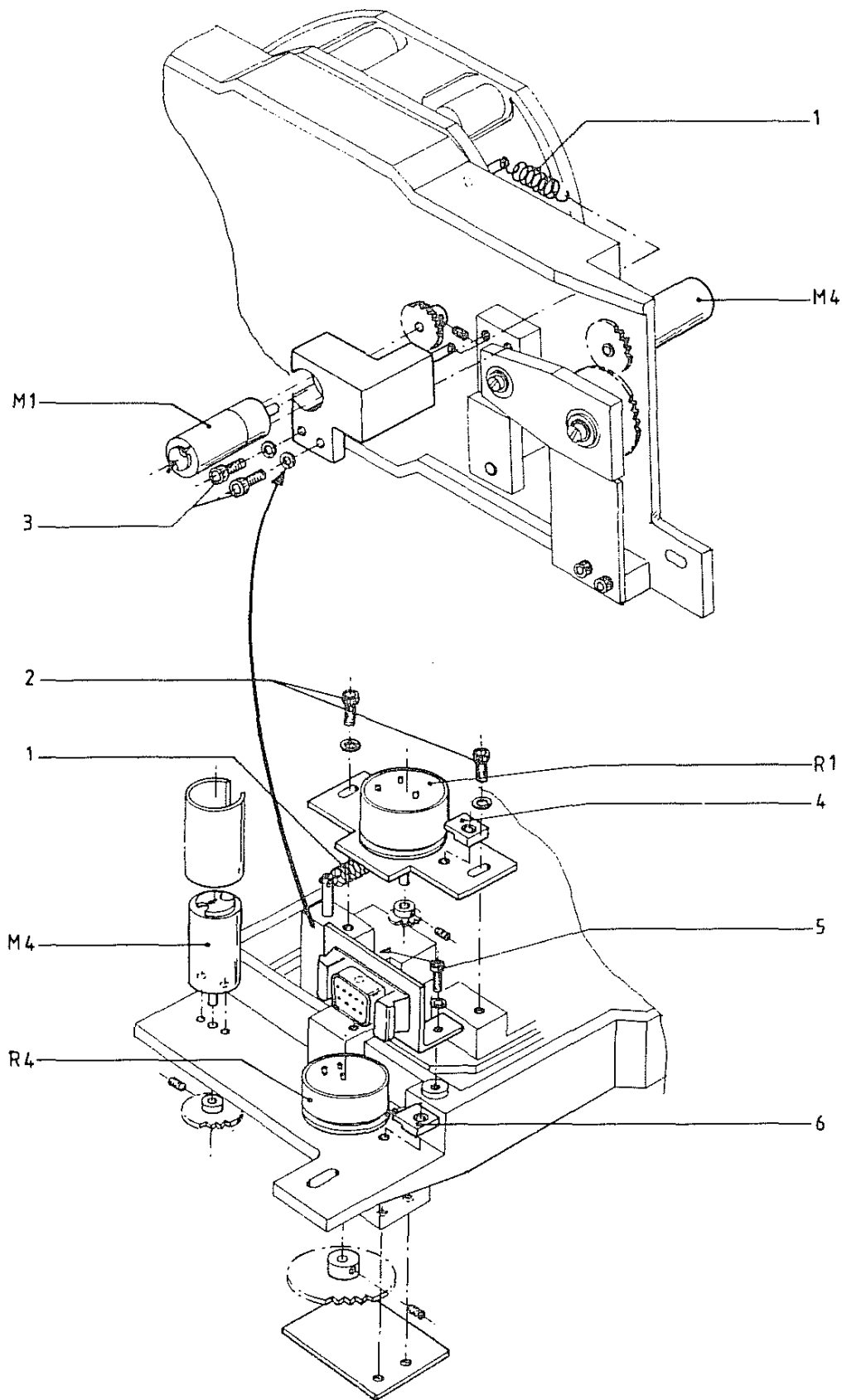
3) Bottom plate removed to reach V-belts for vertical movement.



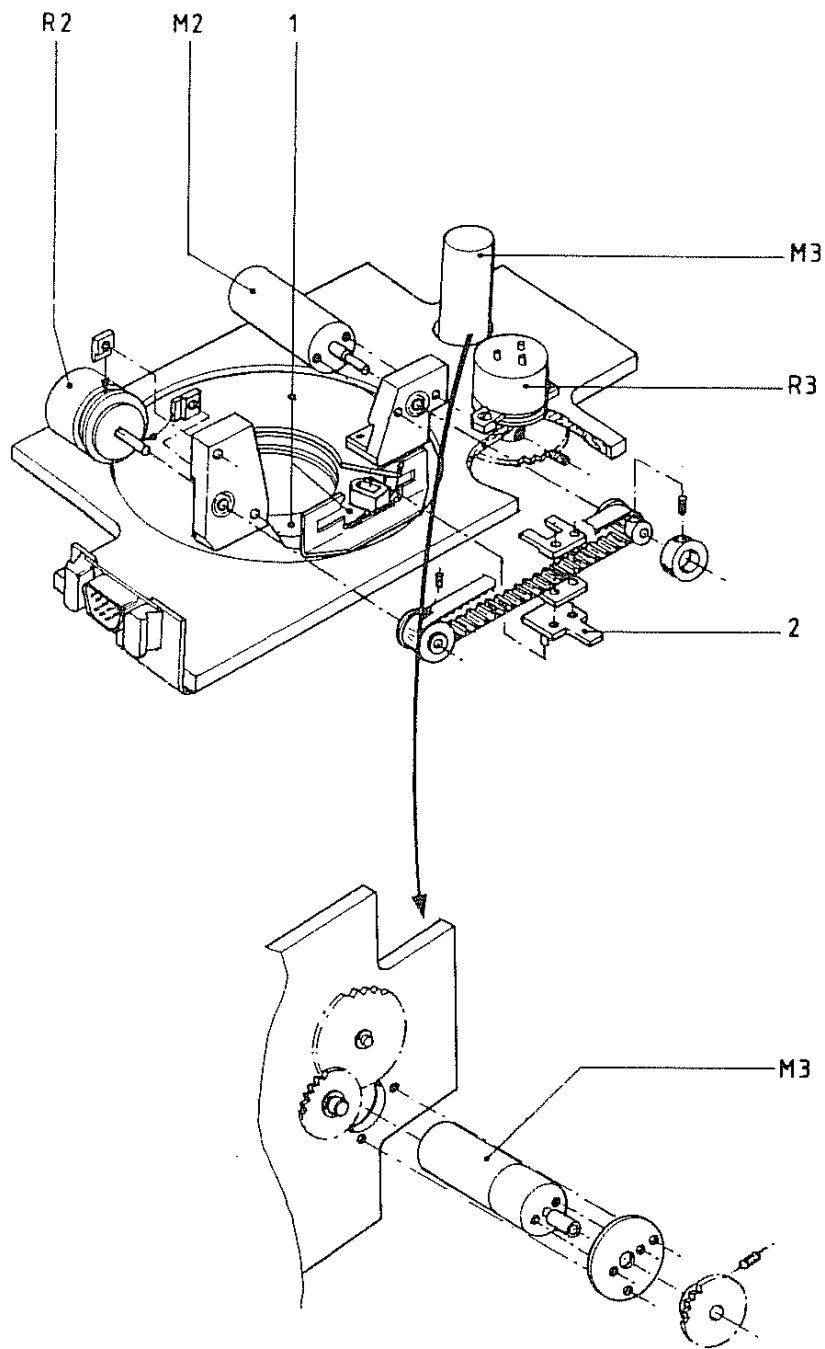
2) The stand compartment is supported by a chair. Mind that the suspension bracket of footswitch is kept free.



4) Detail of stand base. Mind the position of side wheel, the wheel holder is resting on the floor. When removing the spindle pulley, a screwdriver can be put through holes in pulley and base frame to keep pulley in position.



IRIS DIAPHRAGM LA

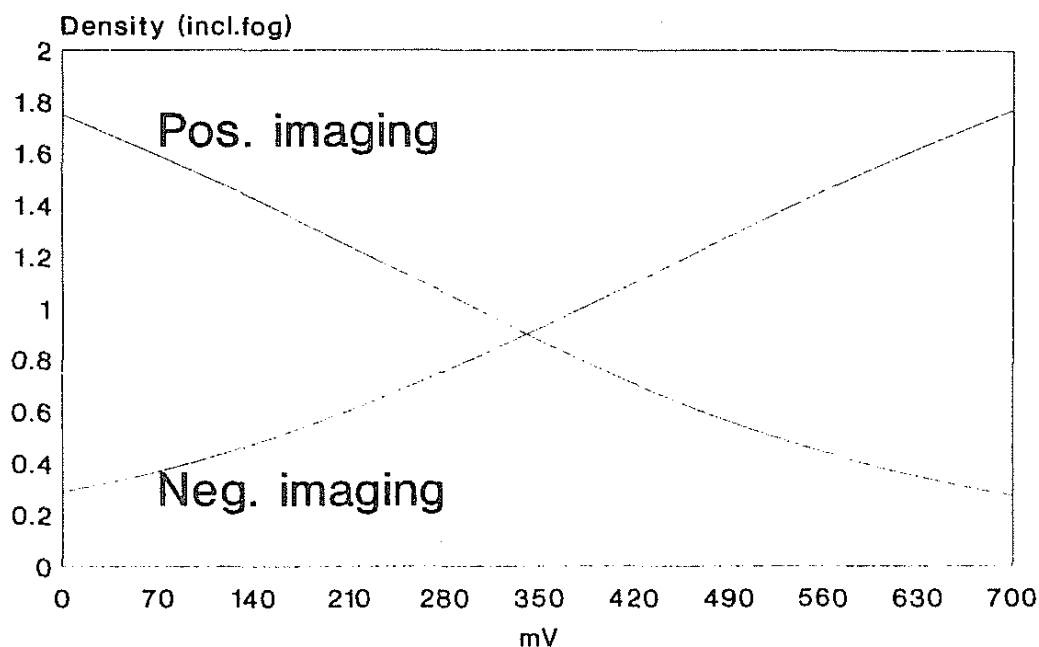


SHUTTER LA

9.1. VHCU DENSITY GRAPH & MASK

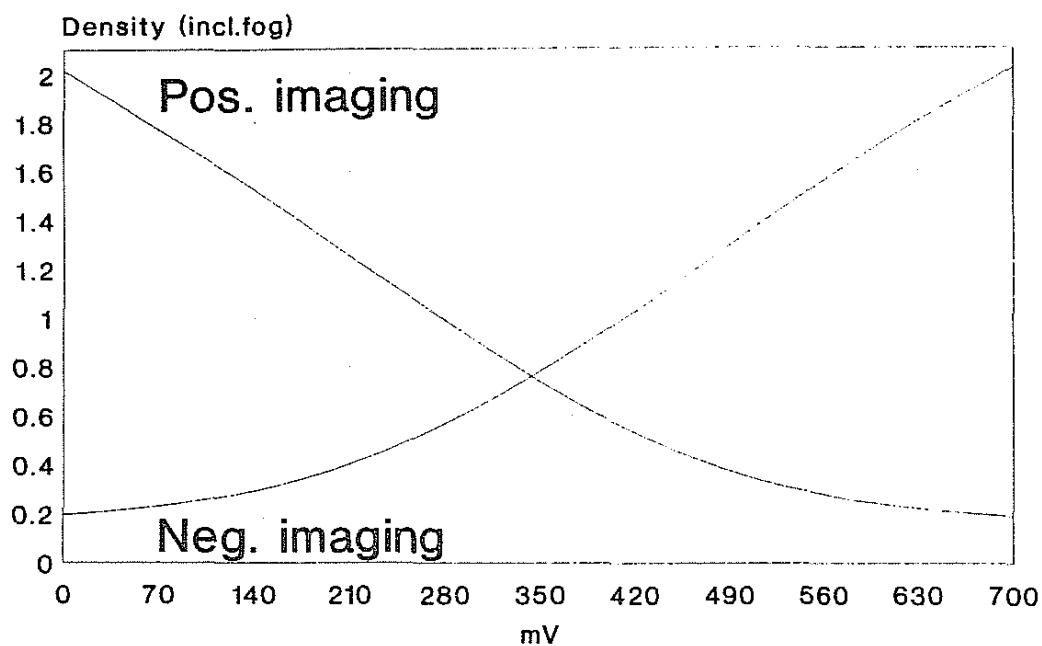
PMI 100-2 Fluoroscopy

B=13 C=150 D=056/064 i=2x



PMI 100-2 Subtraction

B=11 C=200 D=056/064 i=2x



Calibration of Video Hard Copy Unit

The Unit is adjusted for Kodak NMB film. Readjusting may be necessary, depending on the developing system or by using other film. In case of readjusting, see service manual System, section F4 (Corrective maintenance / adjustments)

Factory adjustment:

Positive				Negative			
Program	BRT	CNT	D	Program	BRT	CNT	D
USR1				USR1			
USR3				USR3			
USR2				USR2			
USR4				USR4			

Film: Kodak NMB
 Developing System: AGFA Curix 402
 Temperature: 31 degr. C

Processing time: 2 minutes

Average Gradient: 2.2 - 2.7

Chemicals

Developer: Agfa Gevaert G138

A/B/C

Fixer: Agfa Gevaert G334

A/B/

Service adjustment: Date: _____ Name: _____

Positive				Negative			
Program	BRT	CNT	EXP	Program	BRT	CNT	EXP
USR1				USR1			
USR3				USR3			
USR2				USR2			
USR4				USR4			

Film: _____

Processing time: _____

Developing System: _____

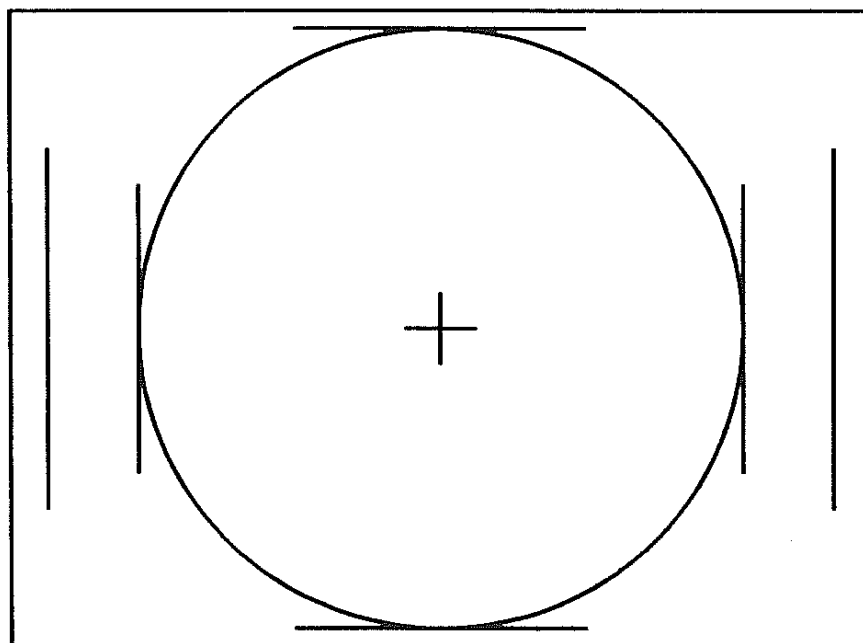
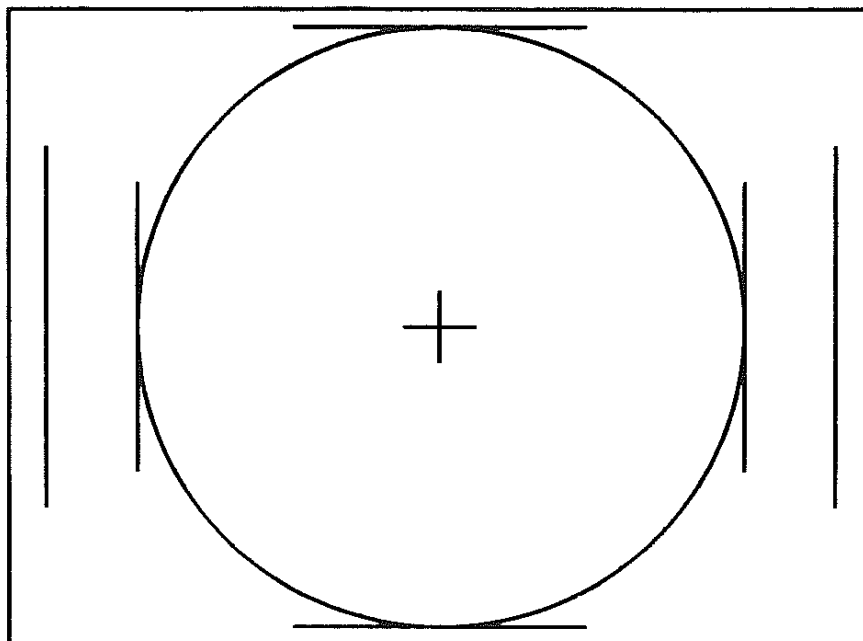
Average Gradient: _____

Temperature: _____

Chemicals

Developer: _____

Fixer: _____



Section G:
Explanations

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1. INTRODUCTION

This section contains a system description of the Mobile Surgical X-ray system BV25 and a description of system functions.

2. SYSTEM DESCRIPTION

2.1. INTRODUCTION

The BV25 is a well-balanced and compact mobile X-ray system for surgical applications in operating and emergency rooms. It is used for radiography with film and cassette and for fluoroscopy with image intensifier and television system.

For fluoroscopy, a Digital Scopofix video memory for the storage of one or more complete TV image can be included.

The BV25 consists of two major parts:

1. Mobile Stand with C-arm and control panel.
2. Mobile Trolley with topmounted TV monitor(s) and Digital Scopofix memory.

Both parts are connected via a stand - trolley cable, plugable at the stand side.

2.2. MOBILE STAND

The mobile stand houses the following items:

1. Mobile stand with C-arm
2. System control panel
3. X-ray control unit
4. X-ray generator and collimator
5. I.I./TV system

2.2.1. Mobile Stand with C-arm

The mobile stand is mounted on a carriage with three freely movable wheels for easy passage and positioning in operating rooms and in corridors. A motor-driven upright column can move the C-arm up and down. Two endswitches limit the travel range. The up and downward movements of C-arm can be operated from both sides of the control panel.

The other movements of the multidirectional movable C-arm are manually performed. The locking mechanisms for the rotational, orbital and scanning movements of C-arm can be engaged from both sides of C-arm. That for the horizontal movement has one handle.

The footswitch is plugable at the stand side by a 6 pins connector. The stand-trolley cable is plugable at stand side by a 35 pins connector.

The 7-meter mains power cable has been fixed at trolley side.

2.2.2. System Control Panel

All controls and indicators have been clearly laid out on a system control panel. For improved cleanability, the switches have been embedded in a flat panel. The flat panel is divided in three sections:

1. Control Section, comprising:
 - Buttons and indicator for power on/off.
 - Button to reset 5-minutes fluoroscopy timer.
 - Buttons for C-arm up/down movement (duplicated at both sides of flat panel).
 - Lamps to indicate radiation present, tank temperature too high and 5-minutes fluoroscopy.
2. Fluoroscopy section, comprising:
 - Buttons and indicators for fluoroscopy mode selection.
 - Button and indicator for Scopofix control.
 - Buttons for setting kV manually.
 - Displays for indication of kV and mA settings.
 - Display for indication of fluoroscopy time.
 - Buttons to control field size of iris diaphragm.
 - Buttons and indicators to reverse image on TV monitor horizontally.
 - Buttons to control slit width and rotation of semi-transparent shutters.
 - Buttons for remote control of image rotation.
3. Radiography section, comprising:
 - Button and indicator for radiography mode selection.
 - Buttons for setting kV manually.
 - Buttons for setting mAs manually.
 - Display for indication of mAs settings.
 - Buttons and indicators for selecting format sizes of diaphragm.

2.2.3. X-ray Control Unit

The X-ray Control Unit provides:

- Processing of settings on system control panel.
- Generation of control- and command signals.
- Display of data for kV and mA and mAs.
- Display and control of alarm- and ready signals.
- Diaphragm control.
- Filament supply for X-ray tube, during fluoroscopy and radiography.

For fluoroscopy the X-ray Control Unit sets up reference voltages for:

- kV control, in manual control mode by conversion of button-setting, in automatic control mode by converting the dose rate control voltage from XTV8S TV chain.
- mA control, by coupling kV/mA values.

It makes a request for fluoroscopy and a high voltage command signal to start the d.c. convertor for X-ray generation per selected mode of fluoroscopy. It outputs data to display kV/mA/mAs values to the control panel. It also counts the integral fluoroscopy time, and outputs this time to the control panel.

For radiography the X-ray Control Unit sets up a reference voltage for kV control, by conversion of kV +/- buttons settings. By counting kV and mAs steps, it reads ROM-data to load an exposure timer, and to display kV and mAs values. It generates an H.V. command to start, after a certain preparation time, the d.c. convertor for X-ray generation.

The X-rays are terminated by the exposure timer.

For radiography the handswitch is used and for fluoroscopy both the handswitch and footswitch are used. For snapshot mode the right hand footswitch is used.

2.2.4. X-ray Generator & Collimator

A fast-response d.c. convertor generator ($f = 300 \text{ Hz}$) supplies the primary voltage to the Practix-C tank. The X-ray tube in this unit has a stationary anode and a double focus: 0.6 mm for fluoroscopy and 1.5 mm for radiography. It provides homogeneous radiation with powerful output (max. 105 kV, 20 mA at radiography). The Practix-C tank has been designed for a duty cycle of 20% at max. values for kV and mA

(Average power = 60 Watt).

The X-ray beam is automatically limited to the input field size of image intensifier during fluoroscopy. Collimation is done by remote-control iris diaphragm and by semi-transparent shutters, allowing collimation

to smaller field sizes, and also giving contrast improvement due to reduced stray radiation.

During radiography, the formats can be:

- $\phi 5$ to $\phi 15$ cm, as set during fluoroscopy.
- $\phi 30(15)$ and $\phi 40(24)$ cm, corresponding to the cassette size in use.

During fluoroscopy the field sizes of iris diaphragm are $\phi 5$ to $\phi 15$ cm. The slitwidth of shutters is adjustable between 1 and 16 cm.

The sizes are measured at the entrance plane of I.I.

2.2.5. I.I. / TV SYSTEM

At fluoroscopy, the combination image intensifier (I.I.)

- Television is used to convert the X-ray quanta to a tv image. The used I.I. tube is very efficient in the conversion of X-rays to free electrons. This means, that a lower dose rate at the input screen can be applied to produce a higher-quality image, so that the radiation dose to the patient can be reduced.

The I.I. Tube converts the X-ray quanta received at the input screen to a light pattern at the fibre output screen, being the image.

The image is transferred from the I.I. Output screen to the input of the ccd camera.

It generates a composite video signal with constant brightness for tv monitor (agc) and a control voltage for automatic dose rate control.

At automatic fluoroscopy, automatic dose rate control (adc) maintains a constant average dose rate, independent of X-ray absorption of object being examined.

A feed back voltage is applied to the X-ray control unit, which adjusts the generator output to achieve the required dose rate at the I.I. Input screen.

2.3. MOBILE TROLLEY

The mobile trolley houses the following items:

1. Carriage
2. Single or double TV monitor set
3. Digital Scopofix memory
4. Scopofix control unit
5. Storage box
6. Mains control unit

2.3.1. Carriage

The mobile trolley exists of a carriage with four steerable wheels. The trolley stores the following items:

- One or two topmounted TV monitors
- Digital Scopofix video memory.
- Scopofix Control Unit.
- Mains control unit.

A Video Hard Copy Unit and Patient Data Unit (options) can also be placed in the mobile trolley.

The trolley includes an accessory box, for storage of small spare parts and service documentation.

The stand - trolley cable is fixed at trolley side, and is plugable at the stand side, via a 35 pins connector.

2.3.2. TV Monitor

The BV25 has been equipped with one or two 43cm TV monitors.

The composite video signal from the XTV8S control unit is applied to the lefthand television monitor. The righthand TV monitor is used to display stored images from Digital Scopofix memory.

Brightness and contrast are adjustable at the monitor.

Image on TV monitor can be rotated, either by local control or by remote control on system control panel. Reversal of left-right positions of TV image can be done by remote control, on system control panel.

2.3.3. Digital Scopofix memory

For the BV25, a Digital Scopofix video memory can be applied. It can store two TV frames in RAM memory. Digital Scopofix MDPM version with disc can also store 34 TV frames permanently on harddisc.

The Scopofix memory provides functions as Last Image Hold at end of fluoroscopy (LIH), Subtract and FIX. All stored images are displayed at TV monitor.

Last Image Hold

During fluoroscopy, a live image is shown on TV monitor. When the hand- or footswitch is released at the end of fluoroscopy, the last image is stored in memory, and this frozen image is displayed at TV monitor.

FIX

FIX exchanges the TV images from lefthand and righthand TV monitor.

Subtract

The SUB function enables the operator to see the difference between a 'mask' image, stored in memory 2, and a live/LIH or snapshot image, stored in memory 1.

2.3.4. Scopofix Control Unit

The Scopofix control unit is the interface between the stand and Scopofix memory. It provides the control for memory and TV monitor, to store and display a fluoroscopy image.

The unit includes a switch 'Memory On/Off' at the rear of the trolley. The switch, in position 'Off', is used to bypass the Scopofix memory in case that the memory is defective.

Now the BV25 can still be used. The monitor shows a live image during fluoroscopy.

2.3.5. Storage

The accessory box in storage compartment contains the following items:

- Spare fuses 10, 15 and 30 Amps.
- Lens paper.
- Equipotential conductor.
- Paint set.
- Silicon grease.
- Cooling paste for CCD camera

2.3.6. Mains Control Unit

The mains control unit is used to connect the BV25 system to the mains via an isolating mains transformer.

The mains transformer provides the following supply voltages to the stand and trolley:

- 600 V to the d.c. convertor.
- 220 V to the monitor, power supply unit and Scopofix memory.
- 28 V to the power control board.

A small transformer with a separate power supply unit supplies the mains control unit.

An enable switch-on line runs over stand-trolley connection cable and all p.c. boards in the mobile stand. When stand-trolley cable and p.c. boards are correctly plugged in, this 'keying' line enables the switch-on circuit.

3. SYSTEM FUNCTIONS

3.1. INTRODUCTION

This chapter contains a functional description of system functions.

The functional diagrams Z1-1 to Z1-13 can be used as reference.

3.2. SYSTEM FUNCTIONS DIAGRAM

(See also Z1-2)

The system function diagram is a summary of all functional diagrams of the BV25 .

Switching on

On depressing the button 'system switch on', the following actions take place:

- A switch-on command to the mains control unit is given, to connect the BV25 system to the mains. Now the BV25 is energized.
- A general reset pulse is generated which sets the BV25 system in fluoroscopy mode.
- An alarm reset pulse resets the X-ray control unit cascade generator (in case of an alarm).

The operator can select fluoroscopy mode or radiography mode. In fluoroscopy mode, the modes automatic fluoroscopy, manual fluoroscopy, intermittent fluoroscopy and single-shot fluoroscopy (snap shot) can be performed.

The signals 'fluoroscopy selected' and 'radiography selected' are never active at the same time.

Setting parameters for kV and mAs

A counter for kV steps is activated by buttons 'kV up' and 'kV down' in both fluoroscopy and radiography modes. The counter is clocked by a fixed frequency (at manual fluoroscopy or radiography) or by a variable frequency (at automatic fluoroscopy). The binary contents of the counter are a measure of kV-button settings. The output of kV counter is connected to a D/A converter (DAC) and two Read Only Memories (ROM).

The DAC converts the binary contents of kV counter to an analog kV reference value KVC. It can vary between 4-10.5 V, corresponding to 40-105 kV for the X-ray tube.

One ROM (fluoroscopy ROM) stores mA values for the coupling between kV and mA, and stores data for the indication of kV and mA values at LCD display.

The radiography ROM stores data for mAs values for loading the exposure timer, and stores data for the indication of kV and mAs values at LCD display.

Using reference values

The kV reference value KVC is used as set value for the high voltage generator. The high voltage generator rectifies 600 V a.c. from the mains control unit by a controlled rectifier. The d.c. voltage is smoothed in power capacitor SEC1, and applied to a DC/AC convertor. The chopped DC voltage is applied to the high voltage transformer of the Practix-C tank. The voltage can vary between 137 V and 405 V, corresponding to 40-105 kV for the X-ray tube.

The mA control signal MAC is used for controlling the tube current, via the filament supply circuit. The mA control circuit controls the tube current by comparing the mA set value (coupling kV/mA) to the actual tube current (MAMEAS).

Alarm/not ready check

The status of the BV25 system is checked for alarm situations and not-ready situations. If a faulty condition (e.g. a short or overvoltage) in the stand is detected, an alarm signal and also a not-ready signal are generated. The alarm signal resets the kV step counter, thus resetting the high voltage to 40 kV. The not-ready circuit inhibits X-ray generation.

X-ray start command

In fluoroscopy mode the handswitch or left hand footswitch produces the signal 'command X-ray by stand' which is applied to the Scopofix control unit. The Scopofix control unit returns by the signal 'command X-ray by Scopofix' which starts the high voltage generator for X-ray generation (high voltage command).

In radiography mode the exposure timer is loaded with preset mAs data, via the radiography ROM. The timer is started on depressing the handswitch, and the high voltage command is active during the exposure time.

X-ray collimation

The X-ray beam is collimated by the iris diaphragm and shutter unit.

During fluoroscopy, the iris diaphragm can be closed and opened by buttons, giving a field size of $\phi 5$ to $\phi 15$ cm. The shutter unit can be closed and opened by button, giving a slit width of 1 to 16 cm. Rotation of shutter unit is done by button, over $\pm 90^\circ$.

All values are measured at I.I. entrance plane.

When switching over to radiography, the iris field size at fluoroscopy is taken over as format size, and the slit width is set to 40 cm.

Format sizes of $\phi 30$ and $\phi 40$ cm can be selected by button, for film cassettes of 24x30 and 30x40 cm (IEC).

Scopofix control

Scopofix controls the routing of XTV8S video signal to and from video memory and to TV monitor(s). It also controls BV25 functions like subtract, FIX and copy. The video memories can store one or two TV frames. The lefthand TV monitor shows Live/Last Image Hold images, the righthand TV monitor always shows stored images from memory.

3.3. MAINS CONTROL UNIT

(See also Z1-5)

The BV25 is connected to the mains via a mains transformer.

The mains control unit switches this transformer via 3 thyristors and an inrush current limiter. It comprises the following parts:

- Mains transformer WAT1.
- Switch-on transformer WAT2.
- Resistors WAR1 and WAR2.
- Thyristors WAV1, WAV2 and WAV3.
- Boards WA1 and WA2.

Thyristors WAV1 and WAV2 are used to connect the mains transformer to the mains.

The resistors are used to limit the inrush-current. After switching-on the BV25, they are bridged by thyristor WAV3.

Boards WA1 and WA2 test the condition of thyristors WAV1, WAV2 and WAV3.

The mains control unit is supplied by switch-on transformer WAT2.

On depressing the power-on button, switch-on relay K1 is operated. It is taken over via contacts of relays K1 and K2, jumper W1 and via the keying line.

The switch-on command (SWONCM) becomes active and via opto-couplers B1-B4, thyristors WAV1 and WAV2 are ignited.

After 0.2 seconds, via opto-couplers B5-B6, thyristor WAV3 is ignited. The power-on lamp lights up and an audible 'beep' is generated.

Now the BV25 is connected to the mains.

Relay K1 can be switched off either by relay K2 or by interruption of the keying line.

Switch-off relay K2 becomes energized either when the power-off button is operated or when alarm from the mains control circuit (MCUAL) becomes active.

The keying line runs over the stand-trolley connection cable and all p.c. boards. It checks if stand-trolley cable and p.c. boards have been correctly plugged-in. If not, the keying line is interrupted. Some p.c. boards have also a relay contact that interrupts the keying line in case of an alarm.

By connecting the mains plug to the wall socket, the mains control unit performs the following tests:
(See also flowchart in Z1-5).

1. Short of both WAV1 and WAV2.

If shorted, the BV25 has been continuously connected to the mains and it can only be switched-off by disconnecting the mainsplug from the wall socket.

Alarm MCUAL is activated and power-on lamp starts flashing. After 0.2 seconds, thyristor WAV3 is ignited to protect resistors WAR1 and WAR2. If not shorted, thyristors WAV1 and WAV2 are ignited on depressing the power-on button. Next, the mains control unit checks for:

2. Conductance of WAV1 and WAV2.

If not conducting, alarm MCUAL is activated and the BV25 switches off.

If conducting, the BV25 is switched-on via resistor WAR1 and WAR2. Next, the mains control unit checks for:

3. Short circuit at mains transformer.

If shorted, thyristor WAV3 is ignited immediately to protect WAR1 and WAR2. Fuses F1 and F2 blow.

If not shorted, thyristor WAV3 is ignited after 0.2 seconds.

Next, the mains control unit checks for:

4. Conductance of WAV3 within 1 second.

If not conducting, alarm MCUAL is activated and the BV25 switches off.

If conducting, the power-on check has finished and the BV25 is standby for operation.

The mains control unit checks continuously if all thyristors remain conducting.

3.4. KV-MA-MAs CONTROL AND DISPLAY

(See also Z1-6)

kV control

The kV step counter exists of 2 up/down counters: counter 1 and counter 2.

For manual fluoroscopy and radiography counter 2 is used, and for automatic fluoroscopy with dose rate control via XTV8S TV chain, both counters are used (higher resolution).

The kV step counter is clocked via F-MAN or F-AUTO.

The counter output settings are a measure of counted clock pulses, i.e. the kV settings.

F-MAN is used in radiography mode and in manual fluoroscopy mode. On depressing the buttons 'kV +' or 'kV -', the kV-MAN oscillator is activated, and the counter is clocked. An up/down control detects whether the counter counts up or counts down.

F-AUTO is used in automatic fluoroscopy mode. The dose rate control signal of XTV8S TV chain is rectified and applied to a voltage-to-frequency convertor (VCO).

The counters counts up or count down, dependent on the dose rate (dose too low resp. too high).

The counters stop counting when the dose rate is correct (F-AUTO --> 0) or at kV range limits (40-105 kV).

The counter outputs are applied to a D-A convertor and two read-only memories (ROM's) via a bus.

The DAC converts the binary output code to the kV control signal KVC. It can vary between 4.0 and 10.5 V, corresponding to 40-105 kV.

mAs control and display

When radiography mode has been selected, the mAs step counter can be clocked. On depressing the buttons

'mAs +' and 'mAs -', a clock oscillator is activated and the counter is clocked.

The binary counter output is used to address a ROM, in which timer data is stored for an exposure timer.

The range is between 0.2 and 80 mAs, corresponding to an exposure time of 0.01 to 4.0 seconds at 20 mA tube current.

ROM addressing

The outputs of kV step counter and mAs step counter are connected via a switch to the address bus of two read-only memories. This switch is activated by the signal SLKV.

In fluoroscopy mode, the signals KV2 - KV8 are connected continuously to the ROM address bus.

In radiography mode, either signals KV2 - KV8 or TM1 - 30 mA are connected to the ROM address bus.

See also memory mapping table in drawing Z1-6.

The fluoroscopy ROM stores the following data:

- kV, mA, mA dec. point values for indication at display.
- mA values for the coupling between kV and mA.

The radiography ROM stores the following data:

- kV, mAs, mAs dec. point values for indication at display.
- Timer data to load the preset mAs values in the exposure timer.

In radiography mode, the radiography ROM is selected, and in fluoroscopy mode the fluoroscopy ROM is selected.

The ROM address is changed every 6.7 msec by timing signals T01 and T02, and the data is available at the ROM databus.

The kV-mA-mAs indication data are applied to a BCD to 7-segment decoder.

The mA decimal point and mAs dec. point data are used to indicate the tens and units of mAs values resp. mA values at LCD display.

The timer data bits TMDAT0 - TMDAT7 are used to load the radiography exposure timer.

The timing circuit generates several clock signals to address the ROM's and to synchronise the dataflow.

mA control

The kV-coupled-to-mA data is latched and next converted to an analog current reference value Iref. This value is compared to the actual tube current Iact, measured by a resistor.

As a result, the signal MAC controls the tube current via the filament supply unit, such that Iref becomes equal to Iact.

See also drawing Z1-8.

For snapshot, the tube current is enlarged with a factor 2.4. This is done by an electronic switch, which connects an extra resistor to the actual tube current signal Iact. This switch is controlled by the RQHIDO signal.

With jumper SE19:W1a set in position 'mA fluo' the control signal MAC is enabled during fluoroscopy.

MPS3 measures 0.3 - 9.3 V. during fluoroscopy, corresponding to 0.1 - 3.1 mA tube current. With jumper SE19:W1b set in position 'mA rad' the control signal MAC is disabled. MPS3 measures 5.0 V. during radiography, corresponding to 20 mA tube current. With jumper SE19:W3 set in position 'service', the tube current can be controlled independent of kV settings (dose rate adjustment).

3.5. FLUOROSCOPY AND RADIOGRAPHY PROCESSING

(See also Z1-7)

The BV25 has 2 modes of operation: fluoroscopy mode and radiography mode.

The modes fluoroscopy or radiography can be selected at the system control panel.

3.5.1. Fluoroscopy Mode

During fluoroscopy, X-ray generation is controlled by automatic dose rate control (via XTV8S TV chain) or by manual dose rate control (kV setting by button). Fluoroscopy can be performed in three different ways:

- Continuous fluoroscopy.
As long as the handswitch or lefthand footswitch is activated, X-rays are generated. TV monitor shows live/LIH images.
- Intermittent fluoroscopy.
X-ray pulses are generated on depressing the handswitch or lefthand footswitch, in order to reduce the X-ray dose to the patient. TV monitor shows a live noise reduced image during the first X-ray pulse only, and shows an image from memory during second and following X-ray pulses. These images are refreshed at the ends of X-ray pulses.
- Snapshot fluoroscopy.
One single X-ray pulse is generated on depressing the righthand (snapshot) footswitch. The dose rate is enlarged with a factor 2.4. The TV monitor shows an image from memory.

Intermittent fluoroscopy and snapshot fluoroscopy can only be performed when a Scopofix memory is installed.

Mode selection

When the BV25 is switched on, a power-on reset pulse is generated to set the BV25 to fluoroscopy mode (IDFLAT signal active).

Now continuous fluoroscopy with automatic dose rate control (automatic fluoroscopy) can be performed.

The modes intermittent fluoroscopy or manual fluoroscopy or intermittent manual fluoroscopy can be selected by pressing the appropriate buttons, even during fluoroscopy.

Pressing appropriate buttons once enters these modes, a second touch releases the modes.

The selected mode is displayed at system control panel via LED's. See also table 'select mode', drawing Z1-7.

The snapshot fluoroscopy mode can be performed by activating the righthand footswitch. The mode is not indicated at system control panel.

Command fluoroscopy

The signals 'handswitch command' (HDSW), 'footswitch command' (FTSW) and 'snapshot switch command' (SSSW)

will generate the signal Command X-ray by Stand (CMXRST) on condition that the BV25 is ready for operation (NOT READY inactive).

The CMXRST signal has the following functions:

- The control unit in the XTV8S TV chain is activated to clear the clean circle at TV monitor.
- (Via a TV delay of 10 msec), the kV step counter is activated to generate reference signals for kV control and mA control. (See also Z1-6).
- The high voltage command for the high voltage d.c. convertor is generated via a mains-synchronisation circuit. (See also Z1-8).
- The timer for counting the integral fluoroscopy time is activated, this time is displayed at LCD display.

The signal CMXRST is applied to the Scopofix control unit, and is returned to the stand as CMXRSC (command X-ray by Scopofix).

At the end of an X-ray pulse, the signal CMXRST becomes inactive and the Scopofix control unit extends the pulse in order to store the last image in memory.

Continuous fluoroscopy control

After switch-on, the BV25 is set in fluoroscopy mode. IDFLAT signal is active and a LED in system control panel is on.

On depressing the lefthand footswitch or handswitch, the signal Command X-ray by Stand is activated and an X-rays are generated as described above.

Now a live/LIH image is shown at TV monitor.

During continuous fluoroscopy, the snapshot fluoroscopy mode cannot be selected.

When intermittent fluoroscopy mode is selected, the signal CONTINUOUS is disabled.

Intermittent fluoroscopy control (See Fig. 1)

At intermittent mode fluoroscopy, two phases can be distinguished. In phase 1 (initial phase), a live noise reduced image is shown during fluoroscopy until VIDEO-OK signal becomes active. The X-rays are terminated and now phase 2 (intermittent phase) is started. After a preset time, X-ray pulses are generated and the TV monitor shows stored images. These images are refreshed at end of the X-ray pulse.

By selecting the intermittent fluoroscopy mode, signals IDFLAT and IDFLIT are active, and the appropriate LED's in the system control panel are on. Before the handswitch or lefthand footswitch is depressed.

The flipflop in intermittent fluoroscopy control is set, and signal INTFLU is active.

On depressing the handswitch or footswitch, signal FLITCM is activated and the Command X-ray by Stand signal is activated via the OR-gate.

X-rays are generated and a live image will be shown at TV monitor until RESET becomes active.

Then the following actions take place:

- Signals INTFLU and INTERMITTENT become inactive, and the X-ray pulse is terminated.
- The oscillator in intermittent fluoroscopy control is enabled, and after a preset time (adjustable between 0.25 and 3.5 sec) the flipflop will be set by the oscillator pulse.
Signals INTFLU and CMXRST become active again, an X-ray pulse is generated periodically.

Snapshot control

By depressing the righthand footswitch, the snapshot mode is selected and signal Request Snapshot (RQSS) is activated. The flipflop in snapshot control is set and signal SNAPSHOT is activated, giving a Command X-ray by Stand.

The X-ray pulse is generated until RESET becomes active, or upon release of righthand footswitch.

When the handswitch or lefthand footswitch is depressed for continuous fluoroscopy or intermittent fluoroscopy, the snapshot mode is disabled and signals CONTINUOUS respectively INTERMITTENT become active.

To enlarge the dose, the signal RQHIDO switches an extra resistor in the filament circuit, as described in chapter 3.1.

The snap shot image is displayed at TV monitor at end of the X-ray pulse.

Reset control

In manual fluoroscopy mode, RESET becomes active 300 msec after CMXRST has been activated. An X-ray pulse of 300 msec is generated.

In automatic fluoroscopy mode, RESET is controlled by the VIDEO OK signal from XTV8S TV chain, or by back-up timer, if the system does not stabilize within 2 seconds (dose rate nor correct).

The time needed to obtain the correct dose rate is about 800 msec, so the first X-ray pulse lasts for 800 msec. For second and following X-ray pulses, (in intermittent fluoroscopy) the stabilization time is about 200 msec.

3.5.2. Radiography Mode

On depressing the button 'select radiography' the radiography mode is selected. Signal Indication Radiography (IDRG) is active and a LED at system control panel is on.

Settings for kV and mAs can be made, as described in chapter G3.4. The timer data from radiography PROM are loaded in the exposure timer.

On depressing the handswitch for an exposure, an exposure preparation timer is activated. During the preparation time of 0.8 sec, the X-ray tube is preheated. The clean circle command is given to show a black image at TV monitor during exposure. After the preparation time, the exposure timer starts counting and signal RADON is active during exposure time of 0.01 to 4.0 sec, and an X-ray pulse is generated.

A back-up timer of 4.5 seconds checks the exposure timer. If the exposure time exceeds 4.5 seconds, signal RADON is made inactive, and a timer alarm is generated.

Now rectified voltage PWRSMDV and feedback voltage PWRSMDV decrease in voltage and trigger signal RECT. TRIGGER gets active again to maintain a balanced condition.

When charging or discharging the capacitor fails, e.g. too long time, alarm signal RECTAL resp. DISAL gets active and switches on a relay to interrupt the PCB KEY sensing line (Enable switch on) causing power down. This situation can be reset by power up again.

The filter circuit is used to suppress interference and spike voltages from thyristors on return lines to the mains.

The inverter power part receives a rectifier-controlled voltage PWRSMDV and supplies a 300 Hz square wave high voltage ACHVT 1-2 in a range of 138 - 405 V to the Practix C tank via a FET switching bridge.

This bridge has 4 FETs.

One half of the bridge works for the positive part of the square wave voltage ACHVT 1-2 and the other half for the negative part. These FETs are controlled in a certain time sequence by triggering signals from power control part.

3.6. HIGH VOLTAGE CONVERTOR

See diagram Z1-8.

The High Voltage d.c. Convertor consists of a rectifier power part, an inverter power part, a power control part and a filament supply. It supplies a 300 Hz square wave high voltage and a 600 Hz square wave filament supply voltage to the Practix C tank and generates clockpulses of various frequencies.

The rectifier power part receives a 50/60 Hz sine wave voltage of 600 Volts from Mobile trolley and directs a rectified and reduced voltage PWRSMDV across a big capacitor to the inverter power part.

It has two thyristors in its rectifier bridge and they are controlled by a trigger signal RECT. TRIGGER from Power control part. This trigger signal controls the amplitude of the rectified voltage PWRSMDV across the big capacitor depending on the reference voltage for kV control and the feed back voltage PWRSMDV.

When this voltage control has reached a balanced condition, the trigger signal RECT. TRIGGER gets inactive, but after a delay of 6 clock pulses a command DISCOM from Power control part gets active to discharge the capacitor for a certain period of time signalled by EL. CAP. DISCHARGE.

The power control part has various circuits to do the overall control of the d.c. converter and to generate clockpulses of various frequencies.

The circuits are:

- Mains synchronized oscillator.
- Measuring and control circuit for reference voltage.
- Control circuit for rectifier power thyristor triggering.
- Timing and decoder/driver circuit for FET switching bridge.
- Safety circuit.

Mains synchronized oscillator.

This oscillator receives a 50/60 Hz measuring voltage of 24 Volts (AC24MW) from the transformer of the power supply unit in the Mobile stand. A double phase rectifier bridge doubles the mains frequency to 100 or 120 Hz and this doubled frequency is applied to a phase-lock-loop circuit. Its output is used as clockpulse for a frequency divider generating output frequencies of 76.8 kHz, 38.4 kHz, 4800 Hz, 1200 Hz and 600 Hz. A frequency signal of 100 or 120 Hz, selectable by jumper W1 is fed back to the phase-lock-loop circuit to correct for deviations in phase and in frequency maintaining the output frequencies.

Measuring and control circuit for reference voltage.
This measuring and control circuit operates in stand-by mode and in fluoroscopy and radiography mode. In stand by mode the KVC-reference voltage and the feed back voltage PWRSMDV are continuously compared and the difference voltage is a measure for the level of VOLT.REF voltage: high VOLT.REF level at no difference and lower VREF level at more difference.

A low VOLT/REF level asks for more capacitor loading by rectifier power giving a higher feed back voltage PWRSMDV.

In fluoroscopy mode the HV COMMAND signal is switched on for an additional adjustment of VOLT.REF level because now the thyristor switching bridge of inverter power draws a current from the loaded capacitor.

In radiography mode also signal RADON is switched on for an other additional adjustment of VOLT-REF level because more current is drawn at radiography. At alarm reset in case of inverter alarm (over current situation) a voltage reference reset circuit provides a smooth control of VOLT.REF level.

Control circuit for rectifier thyristor triggering.

This control circuit produces signal RECT. TRIGGER to load the big capacitor and signal DISCHARGE COMMAND to unload this capacitor.

The RECT. TRIGGER signal is controlled by a comparator output with a variable pulse width and during this pulse width trigger pulses of 38.4 kHz are passed through to the rectifier thyristors. To the inputs of the comparator are applied a 100/120 Hz saw tooth signal and the VOLT.REF level. These input signals are compared and the lower the VOLT.REF level the larger the pulse width is at comparator output, causing a large number of trigger pulses to pass via RECT. TRIGGER. As a result, VOLT.REF level will increase in voltage and the pulse width get smaller.

This goes on up to the moment that VOLT.REF level exceeds the amplitude of the sawtooth signal at the comparator input. Then the comparator stops output pulses. This means that voltage PMRSM at the big capacitor has reached the required level.

Now the comparator output releases the reset input of a discharge command control circuit and this circuit produces a delayed DISCHARGE COMMAND signal to rectifier power to unload the big capacitor. This unloading lowers the PWRSMDV voltage and causes a decrease in voltage of VOLT.REF level. Then the comparator starts again output pulses, which cause reset of discharge command control and release of rectifier trigger control.

Rectifier trigger control is disabled when:

- Voltage PWRSMDV (reduced capacitor voltage) exceeds a maximum limit or
- Over current signals an inverter alarm or
- Capacitor is unloaded (EL.CA. DISCHARGE).

The alarm signals RECTAL and DISAL get active when the maximum limit has been reached resp. the discharge timer expires. Then loading resp. unloading the big capacitor fails and RECTAL resp. DISAL signal cause power down.

Timing and decoder/driver circuit for FET switching bridge.

This circuit provides timing of trigger pulses and decoding/driving of FETS in the switching bridge.

This timing and decoding controls the triggering of FETS such, that the FETS bridge switches in a certain time sequence and in the required order to supply a 300 Hz square wave high voltage.

HV COMMAND makes signal HVON to initiate the timing of trigger pulses and to set up a half of FETS switching bridge for the first commutation.

Signals FFO and FFON select each a half bridge and two FETS are used for a half-bridge operation.

Signal HVTDV is a voltage level derived from voltage PWRSN at the big electrolyte capacitor.

The voltage level of HVTDV is a measure for the high voltage to be supplied to the high voltage transformer in Practix C tank. The timing circuit uses the HVTDV level to control initially the first pulse width of the square wave output voltage.

A higher voltage makes this first pulse width shorter and so the power to the high voltage transformer is limited as switching on high voltage.

Safety circuit.

This circuit enables high voltage switch on for radiation at the last possible stage of the d.c. converter. At this stage is checked whether both High Voltage Command and Hand/Foot switch command are given and then the radiation present indication may light up.

Filament supply provides the filament transformer in Practix C tank with power for small focus at fluoroscopy and for large focus at radiography.

At fluoroscopy the mA control signal adjusts the current of +24 Volts supply to the required value by regulating a power transistor. The value of the current is proportional to the tube current in a range of 0.1 mA - 3.1 mA. This +24 Volts power supply is converted into a 600 Hz square wave supply voltage, applied to the small focus filament transformer via a relay contact.

At radiography the Select Rad. signal adjusts the current of +24 Volts supply to the required value for preheating the filament.

The Exposure command readjusts this current to a higher value meeting the exposure current of 20 mA. At radiography the relay contact is switched over to direct the 600 Hz square wave supply voltage to the large focus filament transformer.

When the current of +24 Volts supply is too high, a filament alarm situation is indicated by FILAL and the power transistor regulation is switched off.

This regulation can be released again by alarm reset. A selecting fluoroscopy and radiography relay contacts are switched over to small focus resp. to large focus.

To switch the contacts sparkless a current blocking circuit switches off the power transistor regulation synchronously with the conversion of +24 Volts supply.

3.7. DIAPHRAGM CONTROL

See also Z1-9.

The diaphragm control is a circuit for controlling the field size of the iris diaphragm, the slit width and slit rotation of the shutter unit and the focus displacement of the diaphragm on switching over from fluoroscopy mode to radiography mode. (small and large focus)

- Iris fieldsize.

Iris diaphragm switches at the control panel adjust the fieldsize by an increase or decrease command to the fieldsize motor.

In fluoroscopy mode, depression of one of these switches enables an 8 bit counter to count up or down. The outputs of the counter are led to a DA convertor. The output voltage of the DA convertor is dependent on the counter state and is used as reference voltage for driving the fieldsize motor.

The actual fieldsize is fed back by a potentiometer (coupled to the motor).

The reference voltage and the feedback voltage are compared to each other and the motor is rotating until the reference voltage equals the feedback voltage.

When the counter gets out of the range limits (ϕ 5-15 cm) it will be disabled and counting stops. At switching over to radiography mode, lamp "< 15" lights up and the commands of the iris diaphragm switches will be ignored.

During radiography the format size can be adjusted by format selection switches F030 (F015) and F040 (F024) (set by jumpers).

Depression of one of the format selection switches causes the lamp "< 15" to extinguish and lamp "F030 (F015)" or lamp "F040 (F024)" to light up.

Further on the output voltage of the DA convertor is switched off and now a fixed voltage is used as reference voltage for driving the fieldsize motor to the selected format.

- Slit width.

Slit width switches at the control panel adjust the slit width of the shutters by an increase or decrease command to the slit width motor.

In fluoroscopy mode, depression of one of these switches enables an 8 bit counter to count up or down. The outputs of the counter are led to a DA convertor. The output voltage of the DA convertor is dependent on the counter state and is used as reference voltage for driving the shutter motor.

The actual fieldsize is fed back by a potentiometer (coupled to the motor).

The reference voltage and the feedback voltage are compared to each other and the motor is rotating until the reference voltage equals the feedback voltage.

When the counter gets out of the range limits (1-16 cm) it will be disabled and counting stops.

At switching over to radiography mode, the DA convertor is switched off and a fixed reference voltage is used for driving the slit width motor to a slit width of 40 cm, measured at I.I. entrance plane.

- Slit rotation.

Slit rotation switches at the control panel adjust the slit rotation of the shutters by an increase or decrease command to the slit rotation motor.

In fluoroscopy mode, depression of one of these switches enables an 8 bit counter to count up or down. The outputs of the counter are led to a DA convertor. The output voltage of the DA convertor is dependent on the counter state and is used as reference voltage for driving the slit rotation motor. The actual fieldsize is fed back by a potentiometer (coupled to the motor).

The reference voltage and the feedback voltage are compared to each other and the motor is rotating until the reference voltage equals the feedback voltage.

When the counter gets out of the range limits ($\pm 90^\circ$) it will be disabled and counting stops.

- Focus displacement.

In fluoroscopy mode a fixed reference voltage is used for driving the focus motor; the motor shifts the diaphragm to the small focus position.

In radiography mode a larger reference voltage is used for driving the focus motor; the motor shifts the diaphragm to the large focus position.

- General

In case of a general reset and during switching over from radiography to fluoroscopy mode, the 8 bit counters are loaded to the maximum content by signal PLH (parallel load). These values are used to set the fieldsize to ϕ 15 cm, the slit width to 16 cm and the slit rotation to a start position of zero degrees.

The "Diaphragm ready" signal is active, when:

- . The iris fieldsize < 15 cm at fluoroscopy.
- . The focus position is o.k.
- . Iris opening for radiography formats is o.k.
- . Slit width \geq 40 cm for radiography

3.8. ALARM/NOT READY CHECK

The not-ready and alarm circuit comprises the following circuits:

- Not-ready circuit.
- Alarm circuit.
- Tank temperature detection circuit.
- Service indication check.

The not-ready circuit checks for the following signals:

- DIRD : Diaphragm ready.
- SCBUSY: Scopifix memory is busy.
- FLTMNR: Not ready by fluoroscopy timer.
- SUPRD : Supply voltages to all circuit boards are present.
- HVRD : High Voltage for DC convertor is present.
- GENRES: General reset is given (at power-on).

If one of these signals is not active, the NOT READY signal is activated. It disables the handswitch or footswitch, and X-ray generation is inhibited.

The NOT READY signals can be displayed on the fluoroscopy timer display by pressing the button 'display error' (DPERCM), next to power-on button. Via the multiplexer MUX, the NOT READY signal is applied to the LCD control board, which displays the message 'ERROR' and a number 1 to 7.

See also table 1 below.

The alarm circuit checks for the following signals:

- HVGAL : High voltage alarm from I.I. generator.
- TIMAL : Timer alarm from radiography timer.
- INVAL : Inverter alarm from H.V. DC convertor.
- MCUAL : Mains Control Unit alarm (thyristor alarm).
- FILAL : Filament alarm from the filament supply unit.
- CLAL : Clock frequency alarm (pulse generator for the fluoroscopy timer).
- TKTPAL: Tank temperature alarm.

If one of these signals become active, the alarm signal is activated.

The 'power-on' lamp starts flashing (1.2 Hz), and the X-ray tube set-voltage is reset to 40 kV.

The alarm signal will be displayed at the fluoroscopy timer LCD display.

The indication 'ERROR' and code number 1 to 7 flash.

Also the not ready signal is activated, thus inhibiting X-ray generation. The alarm set by INVAL, FILAL or HVGAL has a memory function. It can be reset by pressing the button 'power-on'. This activates a one shot generator, and an alarm reset pulse 'ALRSCM' is generated.

The error code list is shown in table 1 below.

In an alarm situation 'ERROR' flashes at 1.2 Hz, in case of a not-ready situation 'ERROR' lights up on pressing button 'display error'.

ERROR	NOT READY	ALARM
1	HVRD---LC	HVGAL--HC
2	not used	FILAL--HC
3	DIRD---LC	INVAL--HC
4	SCBS---HC	MCUAL--HC
5	SUPRD--LC	TKTPAL-HC
6	GENRES-HC	TIMAL--HC
7	FLTMNR	CLAL---HC

Tank Temperature Detection Circuit

The tank temperature is measured with a NTC resistor in the Practix C tank.

The resistance value is led to three comparators:

- (1) The first comparator switches over at a tank temperature $> 50^{\circ}\text{C}$ and the lamp "indication tank temperature" at the control panel will light up continuously. When the tank cools down to $< 48^{\circ}\text{C}$ the lamp will extinguish.
- (2) The second comparator also switches over at a tank temperature $> 70^{\circ}\text{C}$ and the lamp starts flashing with a frequency of 1.2 Hz. Also the signal "tank temperature too high" is then active, which enables an acoustical signal, as long as the hand- or footswitch is depressed. When the tank cools down to $< 60^{\circ}\text{C}$, the second comparator switches back and the lamp stops flashing and will light continuously again. The signal "tank temperature too high" becomes inactive.
- (3) The third comparator also switches over at a tank temperature $> 75^{\circ}\text{C}$. The lamp "indication tank temperature" continues flashing and flip-flop "not ready by tank temperature too high" is set and the signal "not ready" becomes active.

This inhibits each form of X-ray generation.
Now also the mains-on lamp starts flashing.

Reset of the flip-flop can be done by:

- . Switching off/on the system (general reset).
- . Cooling down period (tank temperature < 68° C)
and no operation of hand-or footswitch.

Service Indication Check

Pressing the buttons 'power-on' and 'display error command' simultaneously, activates the signal 'Service Check command'.

The following situation is indicated:

1. All lamps on control panel are lighting.
2. All numbers and codes of the LCD display light up:
Indications 188 kV, 88 mAs with decimal point at radiography display, 188 kV 88 mA with decimal point at fluoroscopy display, and 88.8 min and ERROR 1..7 on fluoroscopy timer display are activated.

3.9. VERTICAL MOVEMENT CONTROL

(see also drawing Z1-9)

The vertical movement control is used to control the motor for up and down movements of C-arm. The range of travel is limited by endswitches SAS2 and SAS3.

On depressing button 'C-arm down', transformer T2 is energized by an oscillator. Thyristors V3 and V4 are ignited and the motor is energized for C-arm down movement.

On depressing button 'C-arm up', transformer T1 is energized and thyristors V1 and V2 are ignited. Also transformer T3 is energized for 0.5 sec, and capacitor C1 is connected in parallel to capacitor C2 for increased torque of motor. The motor is energized for C-arm up movement.

The brake is active when no C-arm up/down command is given.

The motor voltage is measured via two opto-couplers.

An alarm detection circuit checks if no up/down command is given and the motor voltage is present. If so, the keying line, that runs over all p.c. boards, is interrupted and the BV25 is switched off.

3.10. SCOPOFIX CONTROL

(See also Z1-13)

Scopofix interfaces between the mobile stand, the Digital Scopofix video memory and TV monitor(s). Digital Scopofix video memories can store one or two complete TV images in RAM memory for temporary storage, and versions with disc can store 25 or 34 TV images on harddisc for permanent storage. The lefthand TV monitor is used to display a live/LIH (last image hold) image, the righthand TV monitor (if applied) displays stored images only.

Scopofix consists of 3 p.c. boards, WHA1, WHA2 and WHA3.

Board WHA1, video routing board, has inputs and outputs to and from the mobile stand, the Digital Scopofix video memory and TV monitor(s). It has inputs for video signals from XTV8S TV chain and from memory (stored images), and has outputs to TV monitor(s).

Board WHA2, Scopofix control board, has inputs and outputs to the mobile stand and boards WHA1 and WHA3.

Main functions: to do a request for X-ray, to select live/memory in the video routing and to control the memory.

Board WHA3, memory adaptation board, adapts the various Digital Scopofix video memories to BV25 systems. It has inputs and outputs from respectively to board WHA2 and Digital Scopofix memory.

SCOPOFIX CONTROL MSP, MDP AND MDPM (See also Z1-14)

Routing of video signals

The live video signal from XTV8S TV chain (VIBS) is applied to video routing board WHA1, where it is led to a video amplifier. The amplified signal is connected to switch S1b and to the video memory.

Switch S1b selects between live video from XTV8S TV chain and video from memory (stored image). After switch S1b, the video signal is buffered and connected to the lefthand TV monitor.

From the video signal a V-pulse and a blank pulse are separated. The use of these signals will be explained later.

On board WHA1, switch S1a is switched to INMEM1 or INMEM2 to display a (averaged) live image or stored image to lefthand TV monitor. This switch is controlled by signals S1M1IN-L and S1M2IN-L. Either signals S1M1IN-L or S1M2IN-L are active, when signal S1LIN-L is inactive.

Switch S2 switches the video from either memory 1 or memory 2 to the righthand TV monitor. Switch S2 is controlled by FIX if jumper WHA2:W1 is in position "2 monitors".

Switches S1a, S1b and S2 are switched V-pulse synchronously. This means that there can only be video-switching after a complete TV-field has been written.

Normally, the video signal from XTV8S TV chain VIBS is processed in Digital Scopofix memory for reduced quantum noise (averaged live, $k=0.5$ or 0.25), but sometimes a "real" live image is displayed on lefthand TV monitor. Switch WHA1:S1b is set in live position when signal WHA2:S1LIN-L becomes active. This signal is only active, under following conditions:

- Digital Scopofix is switched off (NOMEM active).
- For Dig. Scopofix with single memory, in FIX mode:
 - . During fluoroscopy (jumper WHA3:W4 in pos. 1 mon.)
 - . Continuously (jumper WHA3:W4 in pos. 2 monitors).

Digital Scopofix memory

The type of Digital Scopofix memory used is detected by signal IDENT2. When IDENT2 is active, a double memory is present. At rear of trolley, you have switch WAS1 (integration high/low).

In case of no memory (NOMEM active), a live VIBS signal will be displayed during fluoroscopy.

The RAM memory in which the video data is stored, is selected by signals MEM1 and MEM2.

In double memories with disc option, the video data may be transferred to Winchester harddisc for permanent storage. To begin transfer, the signal STORE is used.

FIX control

For Digital Scopofix used with double monitor, jumper WHA2:W1 is always set in position 2 monitors. FIX exchanges TV images from lefthand TV monitor and righthand TV monitor.

When FIX is not active, signals S1M1IN-L and S2M2IN-L are active, and the contents of MEM1 are applied to lefthand TV monitor, and contents of MEM2 are applied to righthand TV monitor.

When FIX is active, signal S1M2IN-L becomes active and S2M2IN-L becomes inactive. The contents of MEM2 are applied to lefthand TV monitor, and contents of MEM1 are applied to righthand TV monitor.

For Digital Scopofix used with a single monitor, jumper WHA2:W1 is set in position 1 monitor.

In case of 2 TV monitors and FIX not active:

Signals S2M2IN-L and S1M1IN-L are active, the lefthand TV monitor shows live/LIH images from MEM1, and righthand TV monitor shows a blanked image (MEM2 not present).

In case of 2 TV monitors and FIX active:

Lefthand TV monitor shows a live image during fluoroscopy, and a blanked image after fluoroscopy.

The righthand TV monitor shows LIH image.

In case of 1 TV monitor and FIX not active:

Signals S2M2IN-L and S1M1IN-L are active, the lefthand TV monitor shows live/LIH images from MEM1.

In case of 1 TV monitor and FIX active:

Signals S2M2IN-L and S1M1IN-L remain active, the lefthand TV monitor shows real live (VIBS) during fluoroscopy and 'old' LIH images after fluoroscopy (no refresh).

START control

On depressing the hand- or footswitch for fluoroscopy, the signal Command X-ray by stand (CMXRST) is generated. This signal is identical to signal Record Command (RECCOM). Signal RECCOM activates the START control for processing the video data in Digital Scopofix memory.

In response to a START command, the memory answers by the BUSY signal.

The signals to control Digital Scopofix memory are shown in timing diagrams 1 to 4 below.

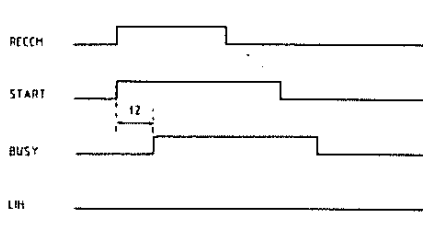
For live fluoroscopy with last image hold (LIH), see timing diagram 1.

For intermittent fluoroscopy, see timing diagrams 2 and 3. Two phases can be distinguished.

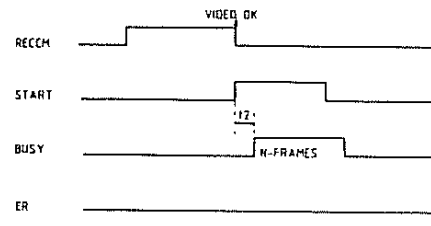
In phase 1 (initial phase) a (averaged) live image is displayed on TV monitor until video-correct signal becomes active. The X-rays are switched off (RECCOM inactive) and now phase 2 (intermittent phase) is started.

In phase 2, a start pulse is generated after each X-ray pulse, and then the LIH image in memory is refreshed.

1. LIVE/LIH FLUOROSCOPY

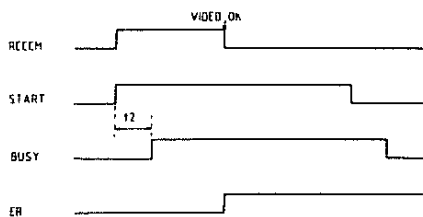


3. INTERMITTENT FLUOROSCOPY (INTERMITTENT PHASE)

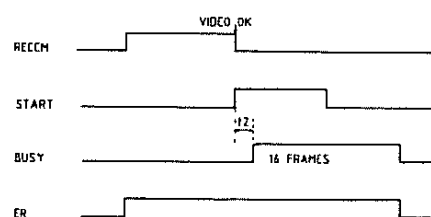


12 = REACTION OF MEMORY
TO START-PULSE
(V-SYNCHRONOUS)

2. INTERMITTENT FLUOROSCOPY (INITIAL PHASE)



4. SNAPSHOT FLUOROSCOPY



For snapshot fluoroscopy, see timing diagram 4. One X-ray pulse is generated until video-correct signal becomes active. The X-rays are switched off and a start pulse is generated to store the image in memory.

On board WHA2, the signal Command X-ray by Scopofix (CMXRSC) is applied to the Stand to start the H.V. convertor for X-ray generation.

Signal CMXRSC is started by signal CMXRST and is extended by signal Record Busy (RECBS-H).

On board WHA3, signal RECBS is started by the RECCOM (i.e. CMXRST). When the hand- or footswitch is released or when video-correct signal has become active, X-rays are terminated. The signal RECCOM becomes inactive and RECBS is extended by a back-up timer of 1 second (max). This extension lasts until the memory has finished storing the video data. Then, the BUSY signal becomes inactive and stops the back-up timer.

In the Mobile stand, signal SCBUSY-H checks for a defect in Digital Scopofix memory. If defective, the BUSY signal will remain active, and X-ray generation will be disabled the next time a fluoroscopy request is made (See also drawing Z1-10).

Noise reduction

The signals LIH and ER on board WHA3 tell the memory which algorithm must be started for noise reduction:

linear integration (ER active) or averaging (LIH active).

Signal LIH is active during live/LIH fluoroscopy and during first cycle at intermittent fluoroscopy.

Signal ER is active during snapshot fluoroscopy and during intermittent cycle at intermittent fluoroscopy.

The noise reduction factors are selected by jumpers WHA3: W3, W4 and W5 (also no noise reduction is possible).

Sub control

Digital Scopofix memories MDP and MDPM have subtract function. BV25 systems can enter the subtract mode by pressing the SUB button on system control panel .

The subtract function can also be entered by pressing FIX button and, within 1 second, COPY button . When the COPY button is depressed, signal STORE is made inactive for a short time to prevent the Scopofix control from storing an image to Winchester disc.

In memory 1, a live/LIH or snapshot "mask" image must be made. This image is transferred to righthand TV monitor by pressing the FIX button.

During fluoroscopy, the lefthand TV monitor shows the subtracted image from memory 2 (LIVE minus MASK), and stores this image as LIH image at end of fluoroscopy.

Pressing the SUB button or FIX button in FIX/COPY) again releases the SUB mode.

Now, the lefthand TV monitor shows the original (non-subtracted) LIH image.

4. LIST OF MNEMONICS

MNEMONIC MEANING

+ -TRV1 Cathode thyristor V1
+ -TRV2 Cathode thyristor V2
+ -TRV3 Cathode thyristor V3
+5V/500E +5V/500 Ohms from memory
+5VDS Memory present detector
+HVT + voltage to inverter circuit
-HVT - voltage to inverter circuit
1200HZ 1200 Hz clockfrequency
30MA--HC 30 mA tube current for radiography
600 HZ 600 Hz clock frequency

AC15V1 AC 15 Volt wire 1
AC15V2 AC 15 Volt wire 2
AC18V1 AC 24 Volt wire 1
AC18V2 AC 18 Volt wire 2
AC24MW1 AC 24 Volt wire 1
AC24MW2 AC 24 Volt wire 2
AC24V1 AC 24 Volt wire 1
AC24V2 AC 24 Volt wire 2
AC28V1 AC 28 Volt wire 1
AC28V2 AC 28 Volt wire 2
AC600VF1 600 Vac for rectifier circuit via fuse
F1

AC600VF2 600 Vac for rectifier circuit via fuse
F2

AC7V1 AC 7 Volt wire 1
AC7V10 AC 7 Volt wire 10
AC7V11 AC 7 Volt wire 11
AC7V12 AC 7 Volt wire 12
AC7V2 AC 7 Volt wire 2
AC7V3 AC 7 Volt wire 3
AC7V4 AC 7 Volt wire 4
AC7V5 AC 7 Volt wire 5
AC7V6 AC 7 Volt wire 6
AC7V7 AC 7 Volt wire 7
AC7V8 AC 7 Volt wire 8
AC7V9 AC 7 Volt wire 9

ACHVT1 AC voltage to HT transformer wire
1

ACHVT2 AC voltage to HT transformer wire
2

ACHVTI-1 AC voltage from inverter to HT
transformer

ACHVTI-2 AC voltage from inverter to HT
transformer

ACTRV1 Anode thyristor V1
ACTRV2 Anode thyristor V2
ACTRV3 Anode thyristor V3

ALARM-HC Alarm signal
ALRS--HC Alarm reset
ALRSCMHC Alarm reset command

BLKCM-HC Block command
BRAKE--L Brake signal
BUSY--H Memory busy indicator

CADOCM-L C-arm down command
CAUPCM-L C-arm up command
CLCL--LC Clean circle command
CMXRSC-L Command X-ray by Scopofix
CMXRSCHC Command X-ray by Scopofix
CMXRSTLC Command X-ray by Stand
COFLCMHC Continuous fluoroscopy command
COFLCMLC Continuous fluoroscopy command
COPYSW-H Copy command
COPYSW-L Copy command
CUTVRDLC Camera control unit television
ready
CUTVRDLC Camera control unit television
ready

DC+10V
DC+15V
DC+18V
DC+24V
DC+5V
DC+6.4V
DC-15V
DC-15V
DC-18V
DC0V

DC0VRF 0V reference for diaphragm unit
DIFS---A Actual value from field size
potentiometer

DIRD--HC Diaphragm ready
DISAL-H Discharge alarm
DISCOMH Discharge command for elco
DPERCMHC Display error command
DRFLDFNA Dose rate fluoroscopy differential
negative

DRFLDFPA Dose rate fluoroscopy differential
positive

DTR1A Detection thyristor V1 wire 1
DTR1B Detection thyristor V1 wire 2
DTR2A Detection thyristor V2 wire 1
DTR2B Detection thyristor V2 wire 2
DTR3A Detection thyristor V3 wire 1
DTR3B Detection thyristor V3 wire 2

DUBLMEMH Double memory
DUBLMEML Double memory
DUBMEMHC Double memory

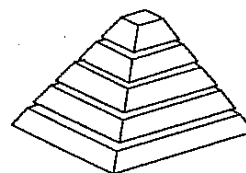
ELDIS-L Elco discharge
ENDSWUPL Endswitch up signal

ENSWDOL	Endswitch down signal	GENRESHC	General reset
ER	Algorithm for noise integration	GTR1A	Gate thyristor 1 wire A
ER-H	Algorithm for noise integration	GTR1B	Gate thyristor 1 wire B
EVLI--LC	Even lines (Scopofix)	GTR2A	Gate thyristor 2 wire A
EXPRCMHC	Exposure preparation command	GTR2B	Gate thyristor 2 wire B
EXPRCMLC	Exposure preparation command	GTR3A	Gate thyristor 3 wire A
EXPTM-HC	Exposure time	GTR3B	Gate thyristor 3 wire B
EXT-L	Auxiliary video signal for lefthand TV monitor		
EXT-R	Auxiliary video signal for righthand TV monitor	H+FTSWHC	Hand- and footswitch command
		HDSW--HC	Handswitch
FEXT---L	External frequency (for intermittent fluo. timer)	HDSWCM-L	Handswitch command
FILAL-HC	Filament alarm	HDSWCM2L	Handswitch command 2
FILCOM	Filament common wire	HDSWSF-L	Handswitch safe signal
FILLA1	Filament large wire 1	HVCOM-HC	High voltage command
FILLA2	Filament large wire 2	HVGAL-HC	Alarm from high voltage generator
FILSM1	Filament small wire 1	HVTDV	High voltage divided signal
FILSM2	Filament small wire 2	HVTDV--H	High voltage divided signal
FIX-H	Fix command	ID5MFLHC	Indication 5 minutes fluoroscopy
FIX-L	Fix command	IDCOP-LC	Indication copy
FLDOCMHC	Fluoroscopy kV down	IDENT--1	Not used
FLUPCMHC	Fluoroscopy kV up	IDENT--2	Double memory present
FMAN--HC	Fixed clock frequency for kV counter	IDER1-HC	Indication error 1
FOCREF	Set value for focus position	IDER2-HC	Indication error 2
FPMT1	Focus position motor wire 1	IDER3-HC	Indication error 3
FPMT2	Focus position motor wire 2	IDER4-HC	Indication error 4
FPPO	Reference signal from focus position potmeter	IDER5-HC	Indication error 5
FSMT1	Field size motor wire 1	IDER6-HC	Indication error 6
FSMT2	Field size motor wire 2	IDER7-HC	Indication error 7
FSPO	Reference signal from field size potmeter	IDER8-HC	Indication error 8
FTR1-2	Fire thyristor V1/V2	IDER9-HC	Indication error 9
FTR3	Fire thyristor V3	IDERDPHC	Indication error display enabled
FTSW--HC	Footswitch command	IDFIX-LC	Indication fix
FTSWCM-L	Footswitch command	IDFLATHC	Indication fluoroscopy selected
FTSWCM2L	Footswitch command 2	IDFLITHC	Indication intermittent fluoroscopy
FTSWCM2L	Footswitch command 2	IDFLMNHC	Indication manual fluoroscopy
FTSWSF-L	Footswitch safe signal	IDRG--HC	Indication radiography selected
		IDSRHOLC	Indication scan reverse horizontal
		IDSUB-LC	Indication subtract
		IDSYON-H	Indication system switched-on
		IDSYON-L	Indication system switched-on
		IDTKTPHC	Indication tank temperature >50 degrees C
GAMMA--1	Gamma correction 1 command (TV monitor)	IMRLCM-L	Image rotate left
GAMMA--2	Gamma correction 2 command (VHCU)	IMROL	Image rotate left
		IMRON	Image rotate (common wire)
		IMROR	Image rotate right
		IMROZ	Image rotate zero position
		IMRRCM-L	Image rotate right command
		INDENB-H	Not used
		INDENBHC	Not used
		INFON-L	Enable input from patient data unit
		INMEM1	Video signal from memory 1
		INMEM2	Video signal from memory 2
		INPON-H	Control signal that patient data unit is used
		INTLOW	
		INVAL-HC	Invertor alarm

IRDECM-L	Iris decrease command	LCDDA6-L	Databit 6 for LCD display (kV-mA-mAs data)
IRDECMLC	Iris decrease command	LCDDA7-L	Databit 7 for LCD display (kV-mA-mAs data)
IRINCM-L	Iris increase command	LCDDA8-L	Databit 8 for LCD display (timer data)
IRINCM-LC	Iris increase command	LCDDA9-L	Databit 9 for LCD display (timer data)
IRREF	Set value for iris field size	LCDDAA-L	Databit A for LCD display (timer data)
K=1	Noise reduction factor K=1 (no noise reduction)	LCDDAB-L	Databit B for LCD display (timer data)
K=1/2	Noise reduction factor K=1/2 (averaging)	LCDDP1-L	Decimal point 1 for LCD display (mA/mAs)
K=1/4	Noise reduction factor K=1/4 (averaging)	LCDDP2-L	Decimal point 2 for LCD display (mA/mAs)
KEY0V	Keying line (connected to 0V)	LCDER1-L	Error 1 in display
KEY1	Keying line 1KEY10 Keying line 10	LCDER2-L	Error 2 in display
KEY11	Keying line 11	LCDER3-L	Error 3 in display
KEY2	Keying line 2	LCDER4-L	Error 4 in display
KEY3	Keying line 3	LCDER5-L	Error 5 in display
KEY4	Keying line 4	LCDER6-L	Error 6 in display
KEY5	Keying line 5	LCDER7-L	Error 7 in display
KEY6	Keying line 6	LCDER8-L	Error 8 in display
KEY7	Keying line 7	LCDER9-L	Error 9 in display
KEY8	Keying line 8	LCDERR-L	Enable indication ERROR in display
KEY8A	Keying line 8A	LCDFLM-L	Select fluoroscopy display
KEY8B	Keying line 8B	LCDTST-L	Test signal to light up all displays
KEY9	Keying line 9	LIH	Algorithm for averaging noise
KVBIT0HC	kV counter bit 0	LIH-H	Algorithm for averaging noise
KVBIT1HC	kV counter bit 1		
KVBIT2HC	kV counter bit 2	MABIT0HC	kV/mA coupling bit 0
KVBIT3HC	kV counter bit 3	MABIT1HC	kV/mA coupling bit 1
KVBIT4HC	kV counter bit 4	MABIT2HC	kV/mA coupling bit 2
KVBIT5HC	kV counter bit 5	MABIT3HC	kV/mA coupling bit 3
KVBIT6HC	kV counter bit 6	MABIT4HC	kV/mA coupling bit 4
KVBIT7HC	kV counter bit 7	MABIT5HC	kV/mA coupling bit 5
KVBIT8HC	kV counter bit 8	MABIT6HC	kV/mA coupling bit 6
KVC	kV-reference signal	MABIT7HC	kV/mA coupling bit 7
LCD100-L	Indication >100 kV for LCD display	MAC	mA-reference signal
LCDCL0-L	Clockpulse for kV display	MAMEAS1	mA measurement signal 1
LCDCL1-L	Clockpulse for mAs display	MAMEAS2	mA measurement signal 2
LCDCL2-L	Clockpulse for fluoroscopy time display		
LCDCL3-L	Clockpulse for fluoroscopy time display	MAREF	Set value of tube current (SE19:MPS2)
LCDCL4-L	Clockpulse for fluoroscopy time display	MCU+15VH	DC+15V from mains control unit
LCDDA0-L	Databit 0 for LCD display (kV-mA-mAs data)	MCUAL-HC	Alarm from mains control unit
LCDDA1-L	Databit 1 for LCD display (kV-mA-mAs data)	MEM1-H	Select memory 1
LCDDA2-L	Databit 2 for LCD display (kV-mA-mAs data)	MEM2-2	Select memory 2
LCDDA3-L	Databit 3 for LCD display (kV-mA-mAs data)	MFSM--L	Measuring field small
LCDDA4-L	Databit 4 for LCD display (kV-mA-mAs data)	MFSM--LC	Measuring field small
LCDDA5-L	Databit 5 for LCD display (kV-mA-mAs data)	MNPH--A	Main phase signal (synchronization)
		MNSYNC	Synchronization signal from the mains
		MON-L	Video signal to lefthand TV monitor
		MON-R	Video signal to righthand TV monitor

MSDOCMHC	mAs down command	S1LINLC	Enables video routing: live to memory-in
MSUPCMHC	mAs up command	S1M1INLC	Enables video routing: memory 1 to monitor-L
NLEA	Safety earth	S1M2INLC	Enables video routing: memory 2 to monitor-L
NOMEM-H	No-memory present indicator	S2M2INLC	Enables video routing: memory 1 to monitor-R
NR1	Noise reduction factor 1	SCBUSY-L	Scopofix busy
NR2	Noise reduction factor 2	SCBUSYHC	Scopofix busy
NR3	Noise reduction factor 3	SHDECMLC	Shutter decrease command
NR4	Noise reduction factor 4	SHINCMLC	Shutter increase command
NTC1	Tank temperature signal 1	SHRLCM-L	Shutter rotate left command
NTC2	Tank temperature signal 2	SHRLCM-L	Shutter rotate left command
NTRD--HC	Not ready situation of BV25	SHRRCM-L	Shutter rotate right command
		SHRRCM-L	Shutter rotate right command
OUT1	Video signal to memory 1	SLECT--L	Select external frequency (intermittent fluoro.)
OUT2	Video signal to memory 2		
OVCURRL	Over current signal (=inverter alarm)	SLFAG	Select fixed AGC
		SLFLATHC	Select fluoroscopy
		SLFLITHC	Select intermittent fluoroscopy
PCBKEY10	Keying line 10 (power backpanel)	SLFLMNHC	Select manual fluoroscopy
PCBKEY11	Keying line 11 (power backpanel)	SLFXGNLC	Select fixed gain
PCBKEY12	Keying line 12 (power backpanel)	SLGAM2-L	Select gamma correction (for VHCU)
PCBKEY7	Keying line 7 (power backpanel)		
PCBKEY8	Keying line 8 (power backpanel)	SLMAN-HC	kV counter is clocked by fixed frequency
PCBKEY9	Keying line 9 (power backpanel)		
PORF	Reference voltage for diaphragm unit	SLREF	Set value for slit width
POWON-H	Power-on reset signal	SLRG--HC	Select radiography
PRRQ--LC	Exposure preparation request	SLRGMOHC	Select radiography (IDRG)
PWR	Power signal	SLRREF	Set value for rotation of slit
PWRGND	Power ground signal	SLYOF-L	Select system switch-off
PWRSM	Power smoothed signal from rectifier circuit	SLSYON-L	Select system switch-on
		SLSYONHC	Select system switch-on
PWRSMDEV	Power smoothed divided signal from rectifier	SLTRON	Select trolley switch-on (stand-alone trolley)
PWRSYN1	Synchronization signal for convertor	SM+LAFHC	Small + large field size
PWRSYN2	Synchronization signal for convertor	SRMT1	Slit rotation motor wire 1
		SRMT2	Slit rotation motor wire 2
		SRPO	Reference signal from slit rotation potentiometer
		SSSW--HC	Snapshot switch
RADPR--L	Radiation present	SSSWCM-L	Snapshot switch command
RADPR-HC	Radiation present	START-H	Start signal for memory
RDPULS-L	Clockfrequency for radiography timer	STORE-H	Copy command for memory
RECBS-H	Record busy signal from memory	SUB	Subtract command
RECBS-L	Record busy signal from memory	SUB1-H	Subtract command
RECCM-H	Record command (i.e. CMXRST)	SVCHCMHC	Service check command
RECTAL-H	Rectifier alarm	SVSLLFLC	Select large focus by service
RECTTR	Rectifier trigger signal	SWMT1	Slit width motor wire 1
RGDOCMHC	Radiography kV down command	SWMT2	Slit width motor wire 2
RGUPCMHC	Radiography kV up command	SWPO	Reference signal from slit width potentiometer
RQSS--HC	Request for snap shot		
RQSS-L	Request for snap shot		
RQSSP-L	Request for snap shot pulse		
RQSTFLHC	Request for fluoroscopy		
RQSTFLLC	Request for fluoroscopy		
RQHIDO	Request for high dose		

TABDO--H	Not used
TABUP-H	Not used
TIMAL-HC	Radiography timer alarm
TM1---HC	mAs counter data 1
TM2---HC	mAs counter data 2
TM3---HC	mAs counter data 3
TM4---HC	mAs counter data 4
TM5---HC	mAs counter data 5
TMADR1HC	Exposure timer address bit 1
TMADR2HC	Exposure timer address bit 2
TMDAT0HC	Exposure timer bit 0
TMDAT1HC	Exposure timer bit 1
TMDAT2HC	Exposure timer bit 2
TMDAT3HC	Exposure timer bit 3
TMDAT4HC	Exposure timer bit 4
TMDAT5HC	Exposure timer bit 5
TMDAT6HC	Exposure timer bit 6
TMDAT7HC	Exposure timer bit 7
TMRSCMHC	Timer reset command
TVSYNC1	TV synchronization signal
UPMAN-HC	kV-counter up/down for radiogr. and manual fluoro.
VIBS	video signal with blanking and sync
VICA	Video from camera
VPULSE-L	V-pulse signal



PARTS LIST

Service

Description : UNIVERSAL PART BV25 XTV8S

Ref. No. : 9896 000 06451

Publication No. : 4522 983 34961

Product Group : 718

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1	2	3	4	5
SB 2	H 1-2 H 3 X 1-SE15X 3	4522 107 96401	pcb lcd control	2x
SB 2		4522 126 33131	LCD "kV-mAs"	
SB 2		4522 126 33141	LCD "min."	
SB 2		4522 103 56082	flat cable	2x
SB 3-4		4522 126 33992	control panel vert. mov.	
SC		4522 126 68353	footswitch (assembly)	
SE	C 1	2022 005 00032	elco 2000uF/450V	
SE	L 1	4522 103 99511	controlled rectif. choke	
SE	R 1	2113 265 00356	resistor pwr 10K/5%/HSA50	
SE10		4522 127 00741	pcb control backpanel	
SE11		4522 107 96702	pcb cons&segm. interface	
SE13		4522 107 96104	pcb general&error process.	
SE15	D13 D14	4522 127 00731	pcb indication processing	
SE15		4522 105 07471	prom fluo. parameter	
SE15		4522 103 99251	prom radiography parameter	
SE17		4522 127 00711	pcb radiogr.&fluo. proc.	
SE19		4522 127 00721	pcb X-ray control	
SE21		4522 107 96802	pcb diaphragm control 1	
SE23		4522 107 96855	pcb diaphragm control 2	
SE30		4522 127 01631	pcb power backpanel	
SE31		4522 107 78513	pcb filament supply	
SE33		4522 127 01601	pcb power control	
SE35		4522 107 78605	pcb rectifier power	
SE37		4522 127 01611	pcb inverter power 1	
SE39		4522 127 01621	pcb inverter power 2	
SM	C 1	2019 317 00034	capacitor 4uF/400V/5%	2x
SM	C 2	2019 317 00032	capacitor 8uF/400V/5%	
SM	R 1-2	2113 265 00169	resistor pwr 3E3/5%/HSA25	
SM	R 3	2113 265 00405	resistor pwr 4K7/5%/HSA25	2x3p
SM	X 5	2422 034 16253	plug UMNL	
SM 1	X 1-SE10X 7 X 3-SUG 1	4522 107 96453	pcb vertical move control	
SM 1		4522 103 55892	connecting cord	
SM 1		4522 103 56022	connecting cord	

SCHEME/ PAGE	1	INDEX	2	CODENUMBER	3	DESCRIPTION	4	DATA	5
WL		L 1		4522 126 56782		indicating lamp X-ray			
WL		L 1		2430 500 00066		housing lamp			
WL		L 1		2430 500 00065		lamp 60-E14-K-024-5W			
WL		L 1		4522 126 56761		lampholder			
WL		X 1		2422 026 00299		plug		3 pins	
WL		X 1		2422 026 00169		connector female		3p	
WL		X 1-WHA 2X 5		4522 103 62941		connecting cord ind. lamp			
WT		X 1-WA/WHA		4522 103 65141		stand-trolley cable			

SCHEME/ PAGE	INDEX	CODENUMBER	DESCRIPTION	DATA
1	2	3	4	5
PZ- 1	bf	2822 075 03153	wheel 125x40	3x
PZ- 1	bg	4522 126 44302	bush	3x
PZ- 1	bh	4522 126 44275	plate. wheel right	
PZ- 1	bj	4522 126 22261	ring	10x
PZ- 1	bk	2622 890 11101	vibration damper	
PZ- 1	bl	4522 126 24441	bush	
PZ- 1	bm	4522 126 08032	shaft footlever	
PZ- 1	bn	4522 126 44423	footlever	
PZ- 1	bo	4522 126 22151	ring	
PZ- 1	bp	4522 126 43812	link	4x
PZ- 1	bq	4522 126 56601	bush	2x
PZ- 1	br	4522 126 56591	ring	2x
PZ- 1	bs	4522 126 43801	fork	2x
PZ- 1	bt	4522 126 43832	block	4x
PZ- 1	bu	4522 125 19801	chain	
PZ- 1	bv	2522 400 10013	flat nut M12	4x
PZ- 1	bw	4522 126 67372	shaft for wheel	3x
PZ- 1	bx	4522 102 80142	countersunk washer	6x
PZ- 1	by	2522 187 21142	countersunk screw M6x12	2x
PZ- 1	bz	2522 674 01084	tapered pin 4x40	
PZ- 1	ca	2512 785 02059	spiral clamping pin 4x20	2x
PZ- 1	cb	2522 674 01079	tapered pin 4x28	
PZ- 2		2522 200 11017	shouldered bolt M5x6x10	2x
PZ- 2		2512 785 02058	spiral clamping pin 4x16	2x
PZ- 2	a	4522 125 17763	pin	2x
PZ- 2	b	4522 125 17723	eccentric shaft	2x
PZ- 2	c	2622 855 39711	supporting roller 35x15	8x
PZ- 2	d	2622 855 39752	supporting roller 24x8	4x
PZ- 2	e	4522 126 34253	shaft	8x
PZ- 2	f	4522 126 34043	retaining ring	
PZ- 2	g	4522 126 34053	bush	
PZ- 2	h	4522 126 34617	grip (left)	
PZ- 2	j	4522 126 43102	plain bearing	
PZ- 2	k	4522 126 43564	lid	
PZ- 2	l	4522 126 33931	spacer	2x
PZ- 2	m	2612 890 11113	buffer D20 H15 M6	2x
PZ- 2	o	4522 126 33513	earth strip	
PZ- 2	p	4522 126 24664	brake assembly	
PZ- 2	q	4522 126 24651	spacer	4x
PZ- 2	s	2622 890 11186	vibration damper D16H10M5	4x
PZ- 2	t	4522 126 34607	grip (right)	
PZ- 2	u	4522 126 34033	stop block	
PZ- 2	v	4522 126 27728	shaft scan brake	
PZ- 2	w	4522 126 27664	lid	
PZ- 2	x	4522 126 56243	cover	
PZ- 2	y	4522 126 43111	locking strip	2x
PZ- 2	z	4522 126 24702	ring	
PZ- 2	aa	2422 135 00013	roller for microswitch	2x
PZ- 2	ab	2422 120 00549	microswitch	2x
PZ- 2	ab	4522 160 34601	isolation plate. long	2x
PZ- 2	ab	4522 160 34402	isolation plate. short	2x
PZ- 2	ac	4522 128 09712	friction ring	2x
PZ- 2	ad	4522 126 43062	roller bearing	

SCHEME/ PAGE	INDEX	CODENUMBER	DESCRIPTION	DATA
1	2	3	4	5
PZ- 3	t	4522 126 50363	grip	
PZ- 3	u	4522 126 43182	plate	
PZ- 3	v	4522 126 44564	disc	
PZ- 3	w	4522 126 44583	plate with brake lining	
PZ- 3	x	4522 126 44002	ring	8x
PZ- 3	y	4522 125 16242	guiding ring	16x
PZ- 3	z	4522 125 18842	bearing bush	4x
PZ- 3	aa	4522 126 44161	bearing block	4x
PZ- 3	ab	4522 126 34633	shaft	2x
PZ- 3	ac	4522 126 57232	bearing block	
PZ- 3	ad	4522 126 72311	bearing pin	2x
PZ- 3	ae	4522 126 72321	bearing pin	2x
PZ- 3	af	4522 126 72331	ring	6x
PZ- 3	ah	4522 126 34655	plate	2x
PZ- 3	aj	4512 909 81801	stop buffer	2x
PZ- 3	ak	4522 126 34642	shaft	
PZ- 3	al	4522 128 09811	bearing block	4x
PZ- 3	am	4522 126 44222	adjusting bearing	4x
PZ- 3	an	2622 115 10012	Belleville washer	72x
PZ- 3	ao	4522 126 44622	pin	6x
PZ- 3	ap	4522 126 44571	disc	
PZ- 3	aq	4522 126 44603	disc	
PZ- 3	ar	4522 126 34914	disc	
PZ- 3	as	4522 126 44612	block	
PZ- 3	at	4522 126 11392	strip	2x
PZ- 3	au	4522 126 56202	shaft	
PZ- 3	av	2622 006 13221	needle bearing NKJ15/16A	
PZ- 3	aw	4522 126 43391	ring	
PZ- 3	ax	4522 126 43383	spacer	
PZ- 3	ay	2622 006 13019	needle bearing 12x24x13	2x
PZ- 3	az	4522 126 50353	grip	
PZ- 3	ba	4522 126 43942	knob	
PZ- 3	bb	2622 008 01059	sleeve bearing bush 15x15	2x
PZ- 3	bc	4522 126 34565	shaft	
PZ- 3	bd	4522 126 56001	centring bolt	2x
PZ- 3	be	4522 126 44211	strip	
PZ- 3	bf	2622 008 01048	sleeve bearing bush 6x10	2x
PZ- 3	bg	4522 125 18582	shaft	
PZ- 3	bh	2622 890 14208	supporting ring 22x30x2	
PZ- 3	bj	4522 126 44191	eccentric	
PZ- 3	bk	4522 125 04681	shaft	
PZ- 3	bl	2622 009 01051	needle-ball bearing	17x30x18
PZ- 3	bm	4522 125 18601	ring	2x
PZ- 3	bn	4522 125 18506	housing brake assy	
PZ- 3	bo	4522 126 44201	compression spring	
PZ- 3	bp	2611 000 03112	bearing bush	
PZ- 3	br	2622 008 01053	sleeve bearing bush 8x12	2x
PZ- 3	bs	4522 126 50333	grip	
PZ- 3	bt	4522 126 43161	stop bracket	
PZ- 3	bu	4522 126 44171	block	
PZ- 3	bv	2522 670 03085	dowel pin 6x24	2x
PZ- 4	a	4522 126 33385	c-arc	
PZ- 4	b	4522 126 33372	block c-arc	

SCHEME/ PAGE	INDEX	CODENUMBER	DESCRIPTION	DATA	
1	2	3	4	5	
PZ- 6	h	4522 126 34131	bolt	4x	
PZ- 6	j	4522 126 42652	cable strip	4x	
PZ- 6	k	4522 126 09241	collector strip		
PZ- 6	l	4522 126 08992	mounting plate		
PZ- 6	m	4522 126 24613	hinge		
PZ- 6	n	4522 126 24421	strip	2x	
PZ- 6	o	4522 126 42673	plate		
PZ- 6	p	4522 126 42552	angular support left		
PZ- 6	q	4522 126 44891	angular bracket left		
PZ- 6	r	4522 126 25441	bracket		
PZ- 6	s	4522 126 22882	tension spring		
PZ- 6	t	4522 126 22763	cam shaft		
PZ- 6	u	2622 008 01057	sleeve bearing bush 12x15	2x	
PZ- 6	v	4522 126 24182	bush		
PZ- 6	w	4522 126 44423	footlever		
PZ- 6	x	4522 126 42522	socket bracket		
PZ- 6	y	4522 126 08961	socket connector	37p	
PZ- 6	z	2422 125 01471	toggle switch	2p	
PZ- 6	aa	2422 034 11592	adaptor BNC-BNC KC99-54	2x	
PZ- 6	ab	4522 126 42662	angular support right		
PZ- 6	ad	4522 126 22964	angular bracket right		
PZ- 6	ae	4522 126 44882	mounting plate scopofix		
PZ- 6	af	4522 103 88771	cap	8x	
PZ- 6	aj	4522 126 68291	leaf spring	4x	
PZ- 6	ak	4522 126 68311	drip tray		
PZ- 6	al	2622 001 30033	ball bearing 8x22x7		
PZ- 6	am	4522 126 57831	rubber foot	2x	
PZ- 6	an	4522 126 42611	wire guide		
PZ- 6	ao	4522 126 24171	ring	2x	
PZ- 6	ap	4522 126 68281	brake foot	2x	
PZ- 6	aq	2622 115 03201	compression spring	2x	
PZ- 6	ar	2622 008 01054	sleeve bearing bush 10x10	4x	
PZ- 6	as	4522 104 26091	wheel with brake	2x	
PZ- 6	at	2822 075 03136	wheel without brake	2x	
PZ- 7		4522 126 50762	handswitch		
PZ- 7	a	4522 127 01821	handswitch panel		
PZ- 7	b	4522 126 50755	housing		
PZ- 7	c	4522 104 10972	retractile cord		
PZ- 7	d	2422 032 00078	contact pin	4x	
PZ- 7	e	2422 015 05037	cable binder	2x	
PZ- 7	f	2422 034 10242	housing M-connector	4p	
PZ- 7	g	4522 126 34112	relief bracket		
PZ- 8		4522 104 41531	cable assy I.I. (packed)		
PZ- 8	a	2422 034 18334	D-connector	9 skt	2x
PZ- 8	b	2422 034 11628	socket contact 0.1-0.26	34x	
PZ- 8	c	4512 100 10641	housing M-connector	20p	
PZ- 8	d	2422 032 00081	socket contact 0.14	54x	
PZ- 8	e	2422 032 00082	socket contact 0.5	18x	
PZ- 8	f	2422 032 00083	socket contact 0.8-1.5	3x	
PZ- 8	g	2422 034 18309	connector HDP-20 25P	25p	
PZ- 8	h	2422 015 14124	socket mod-V 0.12-0.56	6x	

SCHEME/ PAGE	1	INDEX	2	CODENUMBER	3	DESCRIPTION	4	DATA	5
~		1				TOOLS IRIS/SHUTTER UNIT			
~		1a		4522 128 27651		adjusting jig diaphragh			
~		1b		2622 150 09002		hex wrench 2.0 (M)			
~		1c		2622 150 09003		hex wrench 2.5 (M)			
~		4				COVERS STAND			
~		4a		4522 126 34352		cover. back (SA)		SAx-side	
~		4b		4522 126 34362		cover. left (SA)			
~		4c		4522 126 34372		cover. right (SA)			
~		4d		4522 126 34412		information cover			
~		4e		4522 126 34341		protective plate			
~		4f		4522 126 25011		vibration plate (200x100)		4x	
~		4g		4522 125 94321		vibration plate (250x166)			
~		5				FOOTSW. SUSPENSION PARTS			
~		5a		4522 126 34472		disc			
~		5b		4522 126 34481		shaft		2x	
~		5c		4522 126 34462		strip			
~		5d		4522 126 50292		suspension knob footswitch			
~		6				COVERS TROLLEY			
~		6a		4522 126 57321		front cover screened.upper			
~		6b		4522 126 22904		side cover. upper		2x	
~		6c		4522 126 22864		back cover. upper			
~		6d		4522 126 42582		front cover. lower			
~		6e		4522 126 22856		side cover. lower		2x	
~		6f		4522 126 42593		back cover.lower			
~		6h		4522 126 22974		cover. instead of recorder			
~		6i		4522 126 22822		half-round cover			
~		6j		2922 715 00329		magnetic lock			
~		6k		4522 125 94321		vibration plate (250x166)		5x	
~		7				ELECTRO/MECHANICAL PARTS			
~		7b		2422 086 00549		UL-fuse 30A/600V		1x	
~		7c		2422 086 00546		UL-fuse 15A/600V			
~		7d		2422 086 00545		UL-fuse 10A/600V			
~		7e		4522 103 55241		potential cable			
~		7f		2432 011 01009		potential compensating pin		3x	
~		7g		2422 028 00229		mains connector			
~		7h		2422 013 00676		clamp 4mm2 9700B/6			
~		7j		2422 013 00719		clamp 10mm2			
~		9				REPAIR PAINTS			
~		9a		1322 054 11156		repair paint. mushroom			
~		9b		1322 051 11168		repair paint. grey			
~		10				PARTS FOR 2X 20" MONITOR			

